Modern Progress in Mine Engineering.

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The great expenditure of time and labor involved in the drilling of holes for blasting, particularly in hard ground, has led to the invention of numerous rock drills to be driven by steam or compressed air. Among the earliest successful ones of these were the Ferroux, and Dubois and Francois, which, with the McKean, are in especial favor on the Continent, where they have contributed in a great measure to the success of the Mont Cenis, St. Gothard, Arlberg, and other important tunnels. In America and England we have quite a considerable number of machines, any of which are capable of, and are daily giving, most satisfactory results, wherever due attention is paid to systematic and orderly arrangements in their use. All these are upon the percussive principle, the drill being attached to the rod of a piston, by the direct reciprocating action of which it is impelled against the face of the rock, the feed being either by hand or automatic. In Brandt's machine, which is held in high esteem in Prussia, the drill is a hollow, cylindrical steel bar, on the end of which are formed five teeth; this is forced against the face of the rock by a hydraulic press, and is rotated by a pair of small hydraulic engines, and cuts a cylindrical hole, the core of which is cleared away by the continuous stream of water escaping from the driving cylinders. The results of a series of trials, extending over ten or eleven months, at Zaukerode, to determine the relative advantages of hand, percussive pneumatic power, and rotary hydraulic power drilling, show, that calling hand drilling unity, the efficiency as to speed of Schram's percussive drill driven by compressed air, was 4.73, and of Brandt's rotary drill driven by hydraulic power, was 5.26; and in cost per metre, again taking hand drilling as the unit, the cost by Schram's drill was .62 to .70, and by Brandt's .60. A rotary drill invented by Mr. Walker is used in Cleveland, the drill being a bar of twisted steel, rotated by a pair of cylinders driven by compressed air.

When neither air nor water power is available, hand drilling machines are sometimes useful. The best known are those of Macdermot, and Baird, both comprising a twisted steel bit, to which a rotary motion is imparted. The advantages of these machines are not so strikingly apparent as to have induced their very extended adoption.

Mention may here be made of the tunnelling machines of Mr. Brunton and Colonel Beaumont, in which the whole face of heading some 7 ft. diameter is ground away at one operation by a series of cutters carried upon a rotating boring head. During this session our members have had the opportunity of seeing the Brunton machine tried practically at a quarry at Bootle; and the Beaumont machine is doing excellent work in the heading of the Mersey tunnel.

The use of explosives of great power is quite a modern innovation. Sombrero, of Turin, in 1847 discovered nitro-glycerine, or glonoin, a heavy yellowish oil, with from five to ten times the explosive force of ordinary gunpowder; but its extremely dangerous character prevented its extensive adoption. In 1864 Nobel introduced dynamite, which consists of diatomaceous earth (*Kieselguhr*) saturated with about three times its weight of trinitro-glycerine. Thus prepared we have a powerful blasting agent which with ordinary care is safe to handle, and great advantages have been gained by its adoption, especially in hard ground, in the lessening of the number and size of the drill holes requisite. Mr. Nobel has since invented blasting gelatine, which is prepared by dissolving collodion cotton in nitroglycerine, and is a jelly-like, almost transparent substance, containing 90% trinitroglycerine. Weight for weight this is about 25%, and bulk for bulk about 40% more powerful than dynamite, and it has already come into considerable use in America; its greatly insensibility to shocks and the absence of dust after explosion, with its greatly increased strength, compensating for the extra cost, which is about double that of dynamite. Other strong explosives in common use are, tonite or compressed gun cotton, and the E. S. M. powder.

The fullest benefit of these modern explosives can only be obtained by the use of strong detonators fired by electricity, by which we are enabled to plant a number of shots in such a manner that when fired simultaneously they shall mutually assist each other, the whole area of level shaft, to the depth of the drill holes, being usually broken out at two discharges. At Prizibram some experiments, carried out with great exactness, showed a saving over black powder of 23% in cost, and 33% in time when dynamite exploded by electricity was used, while with safety fuse and caps the saving was 9% in cost and 15% in time. The frictional electric machine of Bornhardt, and the magneto-electric exploder of Siemens, are both effective and in considerable use, the latter being perhaps less liable to derangement by damp or neglect.

For coal getting these explosives are too quick, and blasting powder continues to be used, the compressed cartridges manufactured by Hall being very handy and convenient. When a "shot" instead of doing its work spends its energy in blowing out the tamping (*i.e.* "a blown out" shot,) it creates a violent sound wave, which is beleved to have caused explosions in collieries by forcing the flame of a Davy lamp through the gauze; and the fire and sparks from such often extend to a long distance; while even in the case of a shot which properly does its work gas may be liberated and fired with the most disastrous results. To obviate or diminish this danger many ingenious methods have been proposed.

Mr. McNab uses water in conjunction with powder or tonite in his cartridges; and in the Lime system of which we have recently heard so much, holes are bored and charged with cartridges of compressed dry caustic lime, into which water is forced with somewhat uncertain results.

Many varieties of wedges have at various times been brought forward, such as the hydraulic wedges of Bidder & Chubb, and Levet; and the combined screw and knee-lever wedge resently patented by Mr. W. F. Hall, and known as the Haswell mechanical coal getter. Unfortunately none of these have yet offered such advantages as to enable them to displace gunpowder, which continues to be used in mines where its use is attended with no serious risk, and it is to be feared in many under conditions very hazardous.

The work of the miner engaged in carving out or holing and cutting a seam of coal is very arduous, and to diminish this toil and lessen the cost and waste of coal involved, a variety of coal cutting machines have been invented. The *idea* of employing mechanical power to accomplish this is not a new one, for a patent was taken out by Menzies in 1761 for working a pick mechanically. But increased attention has of late years been given to the subject. One of the earliest of the modern machines is Frith's in which a pick is actuated by a small air engine in much the style of the collier. The machines of Winstanley, and Rigg and Meiklejohn have the cutters arranged on the periphery of a rotating disc, and "saw" out a groove after the manner of a circular saw. In Baird's the cutters are fixed upon a travelling pitch chain; while in the Lechner, an American machine, the cutters are mounted on a revolving bar driven by pitch chains. Coal cutting machines have not come into extensive use, for, as hitherto constructed, they necessitate a costly plant, are cumbrous to move about, and are only effective in a tolerably long and straight face, such as cannot be maintained except with a pretty good roof and even, quiet floor, and they offer but a slight diminution (if any) in the cost per ton. The advantage to be obtained from them is chiefly in a thin and hard seam, in the increased percentage of large coal.

Fifty years ago few shafts in England exceeded 300 yards in depth, but with the great development which has taken place in recent years, increased depth has been attained, and there are now at work a number of shafts over 500 yards, and a few reach from 640 (Pemberton) to 900 (Ashton Moss,) the diameter having also been increased from 10 or 11 ft. to 16, 18, and even 20 ft. On the Continent are several shafts ranging from 833 yards (Sacré Madame) to 1224 yards (Adalbert Prizibram,) the latter being the deepest in the world. The superiority of the circular form of shaft is becoming more fully recognized and, this form is now very generally adopted in stratified measures; and the economical necessity for better winding appliances is leading to an appreciation in the metaliferous districts of the advantages of downright or vertical shafts, and some form of guides, over the older plan of having vacant inclined and zig-zag shafts, through which the kibble bangs and bounces in its erratic career to the surface.

Increased speed in shaft sinking has been gained by better organization of labor. The Hindley Field shaft, 15 ft. diameter, was sunk by the ordinary appliances at a rate of 5.73 ft. per 24 hours; while at Houghton Colliery, near Barnsley, 9.21 ft. per 24 hours were sunk, the holes being drilled by hand and fired by electricity. Considerable success in America has attended a system of sinking, in which a series of holes were drilled by a diamond drill to a certain depth, and having been filled with sand, were blasted away in sections, so saving the delay and loss of time caused by having to refix the drilling tackle after each blast.

Colliery shafts are now very generally lined with brickwork, but at Saarbruck iron has been successfully applied to this purpose. Rings of T or channel section are fixed at intervals of about 39 in. and a lining of 2 in. oak planks placed behind those rings. In the most recent example, a 12 ft. diameter shaft has been lined entirely with iron rings of channel section being placed at intervals of 39 in. as before, but the intervening spaces are cased by wrought iron sheets of $\frac{3}{8}$ in thickness. All these being carefully prepared on the surface, it is said that a great saving of time in placing the lining is effected, and a reduction in cost of 30 to 40 per cent. How far this may possess the requisite element of durability is an unsettled point, but if backed by concrete there seems no reason why such a lining should not prove very effectual, especially in downcast and moderately dry shafts.

But the greatest difficulty met with in shaft sinking is due to the presence of water either in the alluvial surface deposits or in water-bearing strata below. In some instances so formidable has been this difficulty as to be overcome only by the most strenuous efforts, and at enormous expense, and often such cost have resulted only in failure. The older methods of passing through these deposits were either by a system of sheet piling in successive tiers, or by running drums of brick, wood, or iron, and these methods have done, and are capable of doing, good service where the quantity of water is not excessively large. Our neighbors in France, Belgium, and Germany have had to encounter great difficulties in this respect, and to them we owe several ingenious and successful methods of overcoming them. The Deutscher Kaiser pit was sunk through 244 ft. of alluvium and 176 ft. of cretaceous maris (without withdrawing the water from the shaft) by a rotating boring tool, fitted with leathern sacks, for removing the material the cast iron lining cylinders following the tool in its downward progress. The first of these cylinders, 17 ft. internal diameter, ran 192 ft., and this was followed by a second, 13 ft. 4 inches internal diameter, which ran a distance of 248 ft., and the whole work was completed in twenty months, of which eleven were spent in preparatory works and nine in actual boring.

The atmospheric system, patented by Sir Thomas Cochrane in 1830, and adopted by M. Triger in 1845, is pretty well known from its frequent employment in sinking cylinders for bridge pier foundations in river beds. Recently it was applied at Bettisfield Colliery, North Wales, in sinking a shaft through 100 ft. of alluvium on the banks of the River Dee, the outer east iron cylinder being 13 ft. diameter, and the inner one 6 ft. diameter with air lock, the cost being about £170 per yard.

Where the ground, while moderately firm, contains heavy feeders of water, the Kind-Chaudron system has proved very successful, numerous difficult sinkings in France and Belgium having been completed at a cost stated to be from £60 to £120 per yard; the deepest yet undertaken being one at Ghlin, near Mons, 1,026 ft. deep and 14½ ft. diameter. In this method the boring is effected by a *trepan*, or boring bar, carrying a series of steel cutters, the action being percussive, and some idea of the magnitude of the operations may be formed when it is known that the large *trepan* weighs 20 tons, while the *cuiller*, or bucket, for withdrawing the debris, has a capacity of 12 tons. In England, two shafts have been sunk at Marsden, near Sunderland, through magnesian limestone so charged with water (the shafts being within 400 yards of the sea) that the attempt to sink by the usual method had to be abandond after the feeders pumped had reached 11,600 gallons per minute. By the Kind-Chaudron system these two pits were bored through the water-bearing stratum to the depths of 217 and 266 ft. respectively, and the water effectually tubbed out, the pits when finished being 12 ft. and 13 ft. diameter. The time occupied in completing No. 1 pit was 20½ months, and the cost averaged £236 per yard, while No. 2 pit occupied 23 months, and cost £168 per yard. Setting aside all questions of time and cost, there is no other system at present known by which the work could have been accomplished at all. The same system has been applied to two 15 ft. shafts for the Cannock and Huntington Company.

For dealing with loose saturated alluvium, Mr. Poetsch has originated the novel idea of freezing the mass to a solid by boring a series of holes, about 3 ft. apart, lined with copper tubes, inside which are smaller tubes. A concentrated solution of the chlorides of magnesium and calcium, at a temperature of about 13° below zero, is then circulated through the

*Retiring address of Mr. H. Bramall, M. Inst. C. E., president of the Liverpool Engineering Society, delivered Dec. 5, 1883.

tubes. After the ground is frozen solid the pit can be excavated in the center of the mass in the ordinary manner, and tubbing put in, and this has been successfully carried out at the Grube Archibald, where 13 ft. of quicksand were encountered at a depth of 100 ft. below the surface.

Allusion has been made to the use of iron for lining and securing shafts, and the same material is coming into more extended use for securing and lining levels, our Continental friends here also leading the way. Uprights and cross trees of —, I and ⊥ section, and about 32 lbs. per yard have been used for main frames, the spaces being covered in by timber in the ordinary manner, though in some cases, ½ in. square bars have been adopted for this purpose with good effect. In England, old railway metals are sometimes used, and make excellent crosstrees or bars. The general conclusion arrived at by the Continental engineers is that the first cost is about double that of wood, but the cost of subsequent maintenance is two-thirds less.

The necessity of keeping back water in a level often arises, and has been met by inserting a dam, formerly a plain, straight brick and cement wall of great thickness, improved by giving it a form segmental in plan; but more recently a spherical form has been adopted, which would seem to be theoretically perfect. The increased depth and size, and consequent cost, of modern colliery winnings necessitate the working of larger areas, and the drawing of greater quantities through a single shaft than was ever contemplated in former days, and so the winding engines recently erected are in some cases, of extraordinary size and power, coupled cylinders of 30 to 40 in. diameter being by no means unusual, while those at Harris' Navigation are 54 in. diameter capable of lifting 6 tons of coal, or including ropes, cages, etc., a total load of 15½ tons at a speed of 32 ft. per second. In a modern plant the speed of the load in the shaft reaches, perhaps, 35 miles per hour, and to enable the engine-driver properly to control his engines, the help of steam driven or steam aided starting and reversing gear, and powerful steam brakes has necessarily been invoked. In England, the strap brake is very general, but on the Continent clip brakes, consisting of massive jaws clipping a brake wheel, and brought into action by a system of levers, are used, and are very effective.

Economy in the consumption of fuel becomes also an important question in deep winding, and the advantages of expansive working of high-pressure steam, and a nicer proportioning of the power expended to the work done have been gained by the application of automatic cut-off-gear. There seems no reason why the benefits of condensing should not also be made available where the requisite supply of water is procurable.

In deep pits the unbalanced weight of the winding-rope, amounting, it may be, to 25 or 30 per cent. of the gross load, becomes an important question, entailing a large increase in size of the engines necessary to start the load, and to meet the difficulty many plans have been proposed. Many years ago some degree of compensation was gained by the flat hemp ropes coiling upon themselves, which were in general use; and similar ropes of aloes fibre are still preferred in Belgium and France, but they are almost entirely displaced in England, Germany, and America by round ropes of iron or steel wire coiling upon a plain cylindrical drum. To counterbalance the rope in these cases, heavy chains attached to a secondary drum, or weighted levers, have been used. The drum has been made conical, the first lift being taken at the smallest diameter, but the extent to which this can be carried is limited, and it is scarcely safe to make the pitch of the cone more than an angle of 30° with the horison. By adding a spiral groove in which the rope can lie, this angle may be increased so as to make the drum almost strictly compensating, and this Scroll Drum (the principle of which was patented so long ago as 1776) is the one now being adopted at most of the largest modern winding plants. Round ropes coiling upon themselves in a vertical groove between two iron discs are in use at Clifton Colliery, near Manchester, and are giving satisfaction, as the ropes are found to retain their form and to wear well. With a plain cylindrical drum the empty winding rope may be effectually counterbalanced by attaching a rope of similar weight underneath the cage. Herr Koepe, of Hannover Colliery, Westphalia, has revived a system of winding, by which the usual drum may be dispensed with, and its place taken by a simple sheave of large diameter, which may be fixed over the shaft (No. 2 Hannover Pit.) The main rope from one cage passes partly round this sheave, and is attached to the other cage, while a secondary rope of like weight hung beneath the cages serves as a counterpoise; or the winding rope may be an endless one passing through the cages, which are attached thereto by clamps. This system is now in work at Bestwood Colliery, near Nottingham.

It has already been mentioned that round wire ropes have in England almost entirely displaced those of hemp, and this result of practical experience would seem to be fully justified by the careful experiments recorded in Germany, from which it appears that, taking the cost per ton lifted by a charcoal iron round rope as the unit, the cost by round steel is 1.6, by flat iron wire 2.4, by flat steel 4.0, and by flat aloes fibre 3.8. The life of a rope, however, will greatly depend upon the good condition and accurate adjustment of pulleys and drums, and the care taken to grease the rope and guard against corrosion and undue friction, the duration of a similar rope having in my experience been doubled by the mere changing of an ill made pulley, all other conditions remaining the same.

The fracture of a winding rope may be, and often has been accompanied by a lamentable sacrifice of life, and to provide a safeguard against this, many have been the contrivances designed to arrest the descent of the cage. A few of them are now in use, among the best, being Calow's, Owen's, and King and Humble's. Except Calow's, which is a neat example of the application of the principles of gravity of falling bodies, all these contrivances depends on the strain of the winding rope for keeping the catches or grips out of contact with the guides, and on the removal of this strain at the top and the bottom of the pit, the grips are brought into action by springs. The risk that a momentary check to the moving load, owing to an irregularity in the engine, may cause the grip to bite and so lead to a serious accident, has prevented many eminent engineers from adopting them.

Should the winding engineman fail to stop his engine at the proper moment, the cage may be carried over the headgear pulley, and to prevent this many ingenious disengaging hooks have been contrived; and as several of these are efficient for the purpose and free from the risks attendant upon safety cages, they having been widely adopted, and are in use at almost every well managed pit. Those of Ormerod, and King & Humble, have found most favor, both consisting of flat tapered plates held in position by a copper rivet. In the head frame below the pulley is fixed a plate or tube, on passing through which the plates of the hook shear off the rivet and liberate the rope, at the same time throwing out projections by which the cage remains suspended by the hook to the plate or tube. Provision should be made by auxiliary catches to prevent the cage falling back in case the suspending chains below the hook should part. At various times apparatus has been brought forward intended to cut off steam and apply a brake should the cage pass a given point, but not with much success.

The basket and trolly formerly used to bring out the coals from the miner, are now superseded by boxes or tubs of wood, iron or steel, running on wheels, and these are placed in cages often of several stories or "decks," to be wound out of the pit. The same method is largely adopted in the metalliferous mines of of the Continent and in America. The shafts are fitted with guides of wood, iron wire, or rigid iron bars. Wood is least costly, is very durable, safe, and in case of accident is easy to repair. Wire ropes are quickly put in, but are liable to oscillation, several fatal and many serious accidents having arisen from this cause, while in case of break down the consequential damage is usually very great. Iron bars of channel or "vignolle" section cost more in the first installation than either wood or wire, and are less easily repaired than wood, but they have not yet been sufficiently long in use to enable us to decide whether they will offer any ultimate advantages over wood.

In the design and construction of head frames for carrying the winding pulleys, a better appreciation of the principles of framing in carpentry is shown than was formerly the case; and for very deep pits, iron has been substituted for timber, either in lattice column, plate web girder, rolled girder, box girder, or tubular girder form.

The Legislature requires that the tops of all shafts when not in use shall be fenced; but at all well regulated collieries, shafts while in use are protected by movable fences, a provision which presents no difficulty, and which has undoubtedly saved many lives. Similar means ought to be taken to protect all openings into shafts in metalliferous mines.

The necessity before alluded to of getting the largest possible daily output of material from some of the very costly modern deep shafts has led to the invention of several schemes for lessening the delay in changing the tubs in the cages. In one plan stages are fixed to correspond with the floors of the cages; in another there are subsidiary cages worked by hydraulic rams; and in yet another the rails in the cages, on which the tubs rest, are tilted as the cage settles on the catches, so as to cause the tubs to run out of the cage, while by similar elevation of rail by a small hydraulic ram the empty tubs run in and take their place.

The difficulties of conveying prompt and distinct signals in very deep shafts have been overcome by the application of electric bells with the best results, and where inclines are worked by engines placed upon the surface, the benefits afforded by this system are very manifest; while the telephone, which has been introduced into several mines, affords an invaluable means of communicating with the surface by audible messages, to the great saving of time and economy of winding power.

The common means of ingress and egress of the miners in metalliferous mines is by ladders, entailing a severe and exhaustive tax upon the energies of the men. To remedy this evil, a machine has been invented, known as the Man-engine, consisting of a reciprocating rod, or rods to which platforms are attached, and on and off which the men step in their progress to or from the surface. This has been extensively applied in Germany, in some instances on a very large scale, as at Przibram, where is one 800 yards deep, intended to be extended to 1000 yards; and another at Clausthal, 712 yards; while several have been introduced into Cornwall. In colleries the custom is to wind the men in the cages used for winding coal, and where downright shafts are available, as in America, this method is also applied in other mines, it being incomparably the best and safest method. The Prussian reports for 1881 give the number of deaths per 1,000 as:—

Where cages and ropes are used	.081
Where ladders are used	.084
Where Man-engines are used	.383

These returns seem to be conclusive as to the esteem in which these clumsy and dangerous machines ought to be held.

The pneumatic system of raising a load (patented in England in 1845*) has been practically applied at Épinac Colliery, Saône Loire, on a large scale, for hoisting coals from a depth of 656 yds., which it is intended to further extend to a depth of 1,093 yards. An air-tight wrought iron tube, 5 ft. 3 in. diameter, is placed in the shaft, and fitted with a piston cage carrying nine tubs, and the air being exhausted above the piston, a load of 3 tons of coal is raised thereby at a rate of about 19½ *inches* per second.

Having to deal with a heavy, bulky commodity of low value, which often has to be transported considerable distances under difficult or disadvantageous conditions, the question of improved means of conveyance has necessarily occupied a large share of the attention of colliery engineers, and its importance is now very generally recognized.

To secure the maximum efficiency, roads underground should be laid out so as to have as easy gradients, and be as straight and free from abrupt turns as is possible. Rails of sufficient rigidity, with broad bearing surface and round tops, should be adopted, and the sleepers should be put in at regular intervals, of say 3 ft., and well packed; the axles of the tubs should be kept well lubricated, and the wheels should be as large in diameter as circumstances will permit. The ratio of dead to live weight should be diminished as far as possible, to which end steel wheels, besides possessing very remarkable durability, will be found to materially contribute. That there is room for improvement will be admited when we remember that the tractional resistance on railways is not more than 8 lbs. per ton and, on street tramways 22½ lbs., while in colliery underground roads and trams it is rarely less than 35, and often reaches 50 and even 60 lbs., surely at least double what it need be.

The transmission of power for underground purposes is scarcely of recent date, and there are few colleries where it is not availed of in some form. In the earliest methods haulage was adopted for inclines by engines fixed either on the surface or underground, the boilers also being sometimes placed below. Steam can be conveyed from the surface in well clothed pipes, for 300 or 400 yards without any serious loss, but the difficulties of disposing of the waste steam, and the risk and dangers attending the placing of boilers underground, have limited the use of such plants to situations near the pits. Hydraulic power has been applied in certain special cases, chiefly for pumping, and in a few cases to drive hauling engines, but this can only be made available where there are facilities for disposing of the waste water. Recently power has been transmitted underground by endless ropes and

* An English patent was granted in 1844 for a system of raising a load by vertical tubes similar to those of the atmospheric railway.

clip pulleys, but this method is of only limited application. The successful utilization of compressed air at the Mont Cenis tunnel showed mining engineers how efficient an auxiliary it might be, and gave an enormous impetus to the application of machinery underground. True, it is not the most economical mode of transmitting power, but it is a convenient one. By it power is easily conveyed, with very small loss in transit, to the most remote portions of a mine, where it may be useful either for hauling or pumping, or for boring or coal cutting; there is no risk of fire, or damage to roads by steam, or waste heat or water; no need for any provision to carry it away when spent, as the very refuse air having done its work becomes a valuable agent in cooling and ventilating the working place, and even leakage from the conveying pipes should not be considered as all loss, since it serves the same useful purpose. The loss due to the heat generated in the compressors has been considerably reduced by M. Cornet's method of injecting water spray, which takes up this heat, and also saves loss by leakage and clearance, and a useful effect in the air of 80 to 85 per cent. is thus obtained. The useful effect got of the air-driven engine, may be taken in practice as about 80 to 35 per cent. of the prime motor, although with the best arrangements an efficiency of 50 per cent. has been recorded.

Seeing how great a share of attention electricity has of late attracted to itself, it is not surprising that its use as a transmittor of power to the interior of mines has been attempted. At the Péronnière mines it is used to convey power from the surface, a distance of about 1300 yards, and is there driving a hauling machine, the useful effect obtained being from 12 to a maximum of 26 per cent. At Zaukerode it is used for haulage by Siemen's electric locomotive, and there and at Blanzy it is used to transmit power to small interior ventilating fans. In England, at Trafalgar Colliery, it is employed to drive a small pump in the workings. The difficulty and uncertainty of maintaining perfect insulation, and the liability to sparks when this fails and when contact is broken, render it inadvisable to introduce such an element of danger into fiery mines; and the small amount of power capable of being thus transmitted, and the low percentage of useful effect obtained, are such as must greatly tend to limit its application to peculiar and special conditions.

The application of power to haulage underground has been greatly extended of late years, the systems which have been found most convenient and economical being the endless rope or chain, and the tail rope. But these systems entail the establishment of fixed engines and long ropes, with liability to derangement at angles and bends in the roads, and some complication at branches. The greater simplicity of haulage by locomotives has induced trials of them, and at Laxey, at Doman in Hungaria, and in America, those of ordinary type have been introduced in adit levels with considerable economy, but they are objectionable from the smoke and steam given off, and of course could not possibly be admitted into any mine liable to give off explosive gases. Locomotives driven by compressed air, carried in a reservoir, were used in the St. Gothard tunnel, and since then in several places, and this plan is adopted in the Mékarski and Scott-Moncrieff trams, and in the locomotive designed by Lishman & Young specially for mining purposes, and now in use at the Earl of Durham's and Cannock and Rugely collieries. Col. Beaumont has constructed a locomotive in which he employs very high pressure (1,000 lbs. per inch,) and the air is expanded in two cylinders but as it requires the use of a stove it is unfitted in its present form for mine use. None of these systems have yet been long enough working to justify an opinion as to whether they offer notable advantages over those with fixed engines.

In the Royal Colliery, Zaukerode, an electrical locomotive on the Siemen's system is engaged in drawing coal tubs along a level, 678 yards, to the shaft, which is about 240 yards deep. The train consists of fifteen tubs of about 1595 lbs. gross weight each, and is drawn out in 4½ minutes, the useful effect being from 21.5 to 30 per cent., of the prime motor on the surface. The cost is a little less than by horses, but the sparks given off on breaking contact with the conductors are an element of danger that could not be tolerated in any fiery mine. The comparative efficiency of the various systems may be approximately stated as follows:—

Endless Rope	power utilised	77 to 92	per cent.
" Chain	" "	75 to	"
Tail Rope	" "	55	"
Compressed Air	" "	30 to 50	"
Hydraulic	" "	25 to 30	"
Siemen's Electric Loco	" "	21 to 30	"
Beaumont's Compressed Air	"	20	"
Electric hauling up incline	"	12 to 26	"

In the economical unwatering of mines no very manifest progress has been made in modern times. Forty or fifty years ago, the Cornish pumping engine had been brought to a degree of efficiency and economy which has not been surpassed by any more recent type; but its large first cost, and generally ponderous character, has led to the introduction of many forms of direct acting engines, cheaper, simpler, and more easy of application, if somewhat less economical in subsequent working. Many of these placed underground are now forcing columns of water to vertical heights of as much as 600 and up to 1,100 feet, the only encumbrance in the shafts being the steam and water pipes, and as the pumps are double acting, and the flow of water practically constant, these pipes for a given discharge may be very considerably smaller than would be required for ordinary lift work. Direct acting engines are either rotary (controlled by a fly wheel), or non-rotary, and of the latter class the one designed by Mr. Davey, with his beautiful differential valve gear, may be cited as an excellent example. This valve gear has also been applied to control Cornish engines with the best results. As might be expected under such heavy water columns some trouble has been experienced with the valves or clacks, and Mr. Davey has got the best results from a modified form of the Harvey & West double beat valve. Direct acting pumps actuated by hydraulic power have been found very useful in draining dip workings, the dispensing with rods, and substitution therefore of a simple line of pipes being a very great convenience; and at Clausthal a pair of rotary engines has been erected, driven by a hydraulic head of 1,959 feet, the pumps being 13 inches in diameter, and 24½ inches stroke, capable of forcing at 12 revolutions per minute 330 gallons to a height of 750 feet, the per centage of useful effects being 35. At lower speeds this duty sinks, and at 3 revolutions is only 15 per cent., and the cost of installation was very great. It could only be under very exceptional circumstances that this would be repeated. In Germany, Rittinger's pump with a tubular rod is regarded very favorably, and has of late been extensively adopted. Among minor but important details, the substitution of wrought iron for cast in main engine beams may be mentioned, the form given being either rolled slabs as at Clay Cross, or built up plate web girders.

In metalliferous mines, and especially in Cornwall where fuel is costly, great attention has always been paid to the construction and setting of boilers, and to contrivances for economising fuel. It is only in recent years, however, that the increasing value of small coal, and, perhaps, less indifference among managers, have caused these matters to receive the attention at collieries to which they are entitled. And accordingly we find the antiquated egg-ended externally fired boiler has followed in the wake of its predecessors—the "haystack" and "wagon"- and has been displaced by the Cornish or Lancashire flued boilers, often with conical tubes and sometimes with mechanical stokers; and where coking is practised, the escaping gases, instead of being a nuisance in the vicinity, are now conducted under the boilers and utilized in the generation of steam. In some cases, by the aid of gas producers, refuse coal is thus utilized, while boilers pipes, and cylinders are carefully covered to prevent waste of heat (silicate cotton being about the best material for the purpose); and the warming of the feed water in some manner by otherwise waste heat, is very generally practiced.

That very difficult problem, how safely to light our fiery mines remains unsolved. No very great advance has been made in recent years, and we still await the discovery of a *safe* safety lamp. The lamps invented by Davy, Stephenson, and Clanny nearly 70, and by Museler over 40 years, ago, none of which are absolutely safe, are still in very general use. The simple expedient of placing the Davy in a close shield or tin can has diminished the risk, and the Marsaut improvements have added to the efficiency of the Museler. In some collieries it is now the practice to test each lamp before use by contact with, or immersion in gas.

The electric light is in use for lighting surface operations, such as screening, etc., for which it is well fitted, and it has been tried underground, but not with very satisfactory results. As a miner's, lamp none of the forms yet proposed are of service. The mine lamp must be self contained, no lamp requiring a detached battery, or having wires attached, is of any use; it must give at least 12 hours sustained light, must be portable, and admit of being placed in almost any position to suit the requirements of the moment, and ought not to exceed 3 to 4 lbs. weight in its complete state, and it must not require any but the very slightest attention on the part of the miner to keep it in order during work.

The furnace, as a means of producing a current of ventilation, is being rapidly superseded by mechanical means. More than three centuries ago, fans were in use on a small scale for this purpose, but it is only in recent years that they have been employed of sizes and capabilities commensurate with the magnitude of modern collieries. The several types in common use, with their efficiency, may be classed as follows:—

Type.	Name.	Efficiency.
Close cased Fans	Guibal	40 to 61 per cent.
" "	Schiele	46 to 49 "
Open running Fan	Waddle	53 "
Displacement Machines	Struvé	58 "
" "	Root	48 "
" "	Nixon	46 "
" "	Cooke	37 "
" "	Lemielle	23 "
Screw	Pelzer	? "

The best fans are decidedly more economical than furnaces, and even were this not so, their greater safety ought to lead to their exclusive adoption in every mine in which there is a possibility of explosive gas ever being met with. Although in the means of generating a powerful ventilating current we may claim considerable improvement, the best methods of distribution are not always practised, and notwithstanding that nearly 80 years have passed away since Buddle introduced the system of splitting the air, and district or panel airing, we find collieries where the advantages thus to be gained are lost sight of. In steep mines, also, more attention should be paid to ascensional ventilation.

To ascertain the quantity of air passing through a road, it is no longer necessary to guess by the aid of a puff of powder smoke, or by carrying a candle with flame kept upright, as did our fathers; we possess now very accurate and reliable Anemometers, which 50 years ago were quite unknown. Those of Biram (revolving vanes,) and Dickenson (vertical vane,) being most convenient and largely used.

In what state does fire-damp exist *in situ*? and what are the effects of varying atmospheric pressure upon its liberation, and is the barometer of any value as a warning of coming danger? These are questions which early attracted attention, and have been much discussed. Mr. Wood has carried out a most extensive series of elaborate and careful experiments to ascertain the conditions as to the solid coal, and Mr. Corbet has rendered a similar service in respect of goafs, and the conclusion seeems to be in both cases, that the barometer affords no reliable indications when to expect danger from gas in mines.

The influence of coal dust in explosions has been carefully investigated, and though it is not established that dust alone may be the cause of an explosion, it is conceded that in a dusty atmosphere ths addition of a smaller quantity of fire-damp is requisite to bring it to the explosive point, and that the effects of an explosion may be intensified and extended by the presence of dust, and accordingly in many very dry and fiery mines, the main roads are kept regularly watered, or, still better by sprinkling salt upon the dust the same object is attained, without the liability of causing the floor to heave and swell.

Several instruments have been devised for detecting the presence of minute quantities of fire-damp in air, such as those of Forbes, Ansell, and Liveing, but none of them are of any practical use to the operative miner, and they are chiefly interesting as very ingenious scientific toys.

A review of progress would not be complete without some mention of the increased safety with which coal mines are now worked. In 1851, the deaths from accidents of every kind in the coal mines of the United Kingdom were 4.56 per 1,000 people employed, while in the decade ending 1860 the ratio was 4.07, in decade ending 1870 it was 3.32, and in the decade ending 1880 it was 2.35, and for the two years, 1881-2, the ratio is 2.081. Without attempting to go minutely into particulars, it may be briefly stated that this marked improvement is entirely in those classes of accidents in the prevention of which improved machinery and appliances, increased knowledge, better discipline, and more competent supervision may be expected to have greatest effect. While on the subject of accidents mention may be made of the Fleuss apparatus, by the aid of which the explorers at Seaham Colliery were enabled to penetrate into the workings a distance of 400 yards in an irrespirable atmosphere.

In cases of accident causing serious injury, the patient's sufferings have often been intensified by his being jolted to his home in a stiff springless cart, but the labors of the St. John's Ambulance Association have extended a knowledge of how to give first aid; and ambulances or stretchers of a simple kind, by which

the pain consequent on removal is much lessened, are now provided at many large mines, and ought to be at all.

The time remaining at my disposal will only permit the very briefest review of the modern improvements effected in the methods employed in bringing to a marketable condition the coal or ore produced from the mine.

The collier does not now usually separate the coal from the slack in the mine, but sends it altogether to bank, where it is screened and picked, to facilitate which operations various ingenious contrivances have been introduced, such as revolving and spiral screens and tables, moving bars and travelling bands, on which the coal is carried past the pickers, while bands and Archimedian screws are used to transport the slack. For all ordinary cases, probably nothing excels the plain flat screen with steel bars, if care is taken to design it of form and pitch to suit the particular circumstances. Iron has been largely introduced in the construction of heapsteads and screens, in some cases with manifest advantage. Where the slack is of suitable quality for conversion into coke it is first washed, the simplest apparatus being the plain long trough, and the washers of Evrard, Sheppard, and some others are in considerable use, and have proved both effective and economical. Elaborate plant has been erected for cleaning slack by the dry or wind process, but the results can hardly be looked upon as quite satisfactory.

New forms of coke ovens have been introduced by Coppée and others which possess certain advantages, though the old bee-hive form is in continued favor by reason of the superior quality of coke produced from it. Several methods are in use by which the recovery of the residual products is more or less successfully accomplished, and the waste gases, as before mentioned, are utilized in the generation of steam.

On the Continent, refuse small coal is ground and mixed with coal tar, pitch, or gluten, and compressed in briquettes, which are used in the French navy and for export, and the industry has there grown to very important dimensions. Some of this "patent fuel" is produced in this country, but the manufacture has never seemed to attract the attention which it merits.

The mechanical preparation or dressing of mineral ores has in modern times been considerably improved, more particularly on the Continent and in America, and the increasing keenness of competition is compelling a closer attention to the matter in this country, with a view to effect greater economy.

The preliminary breaking, picking, and sorting to which the stuff is first subjected, is now in many mines materially aided by the use of Blake crushers. Why should not a very much extended use be made of these machines? The cost of this preliminary breaking by machine is about half the cost by hand, besides which, the efficiency of the stamps or rolls to which the stuff is next passed is materially (from 20 to 40 per cent.) increased.

Not much alteration has been made in the form of the gravity stamps commonly used in this country. They remain much what they were upwards of 300 years ago, and in some cases so ill-constructed are they, that not nearly the efficiency of which they are capable is got out of them. The Americans have greatly modified and improved the common stamps by making the lifters of round bar iron and the cam shaft of wrought iron, with steel cams, which communicate to the heads a revolving motion at the moment of their release. The heads are made much heavier, and the lift lower than is usual with us, and the coffers are of iron and carry dies, while the frames are also in some cases of wrought-iron. These improvements have been adopted by the best makers here in machinery made for export. But gravity stamps at their best are costly and somewhat cumbrous appliances, and can get through a comparatively small amount of work; the average in Cornwall not being more than one ton, and in America a little over two tons per head in 24 hours. The desire for something more efficient led to the introduction of the pneumatic stamp of Mr. Husband, in which, by the use of the air spring, the speed and weight of the blow is so increased that 20 tons are stamped by one head in 24 hours, and the cost of a given amount of work is reduced about 40 per cent) Other recent stamps are the Elephant and the American Springbeam. The application of steam direct to lift the stamp head, simple as it seems at first glance, is a by no means easy matter, and stamps so worked will necessarily be expensive; but at the Lake Superior Copper Mines, the Ball direct acting steam stamp is in much favor, and is stated to crush with one head of 2 tons about 120 tons of rock in 24 hours, through grates having ½ in. diameter holes.

It would be utterly impossible, within the limits of time at our disposal, to give any adequate idea of the ingenuity and fertility of resource displayed in recent years in the application of machinery to the treatment of the ore after leaving the stamps or crushers. Merely to enumerate the various pulverisers, disintegrators, jiggers, concentrators, dressers, etc., etc., now in use would occupy considerable time, and such a cursory glance would serve little useful purpose. Suffice it to say, that at no previous period has dressing been better understood or been more carefully and efficiently performed, and that in most mining districts there is a great deal of activity displayed in the devising of new methods, or improvement of those processes already well known, it being felt and generally admitted that although much has been done, there still remains much to do before the art may be called perfected.

And now I must bring to a close this very brief review, in which I have endeavored to place before you not only a retrospect of the past, but an epitome of the present state of the art of mining, and have had occasion to point out directions in which tentative efforts after improvement are being made, although they have as yet in many instances scarcely got beyond the region of successful experiment. I have to thank you for the patience with which you have listened to me, and hope I may be permitted to remind you that the two cardinal points of the greatest safety for the employés, and the greatest economy in the working, are those which in his search after improvements ought to be kept steadily in view by every Mining Engineer.

THE NICARAGUA SHIP CANAL.—The text of the concession for an inter-oceanic ship canal and railway, granted by the Nicaraguan government and referred to by President Arthur in his message, is given below:

"The company secures the exclusive priviege to construct a ship canal across the territory of Nicaragua. The canal is to be of sufficient dimensions to accommodate steamers of the largest size plying between Europe and America, and the locks are to be not less than 500 feet long and 28 feet deep. The concession is for ninety-nine years from the opening of the canal for general traffic, and at the expiration of that period the Nicaraguan government is to take possession of the canal in perpetuity, the right, however, being reserved to the company to lease it for another ninety-nine years. During the period of concession the company is to have the privilege of constructing a railway along the whole or any part of the canal; also such telegraph lines as it deems necessary for the construction and working of the canal, and these lines shall transmit public messages free of charge. The government of Nicaragua declares the terminal ports and the canal itself throughout its length to be neutral, and agrees that the transit in case of war between other Powers and Nicaragua shall be uninterrupted. In general the canal shall be open to free navigation of all vessels, provided they pay the dues and observe the regulations of the company.

Troops of foreign nations will be allowed to pass through the canal under the regulation of existing treaties. Vessels-of-war belonging to other nations engaged in hostilities with Nicaragua or any other Republic of Central America will be rigorously excluded. An effort will be made to secure a guarantee from all Powers of the neutrality of the canal and of a zone along it and of the sea in the vicinity of the terminal ports where the dimensions will be defined. This concession, with all its advantages and privileges, will appertain to the company, and in no case can they be transferred to a foreign government or Power. The company is to be organized in the usual manner of such enterprises, and its designation will be "The Nicaragua Ship Canal Company." The company is to be allowed to bring immigrants to Nicaragua freely from any part of the world and is to be exempt from every form of taxation during the period of the concession."

NEW YORK, Dec. 12.—The organization of 130 new corporotions was reported during the past week to the *American Business Guide*, New York, against 94 the previous week. Of the former, eleven, with an aggregate capital of $1,190,000 are for electrical purposes: six are gas and water companies, with capital of $1,675,000; sixteen are devoted to grain, provisions, live stock, etc., with capital of $724,000; twenty-three, with $10,080,500, are for land and building purposes; twenty-four, with capital of $12,124,000, will build machinery, etc.; fourteen, with $20,495,000, will engage in milling and mining; nine, with $571,000, are for printing and kindred purposes; eight, with $8,975,500, will build railroads and railway appliances, while twenty are for about that number of different purposes with $639,000 capital. The total capital stock aggregates $56,464,500.

SELECTED MISCELLANY.

THE trials of the six-inch-bore Haskell multicharge gun were resumed at the Government proving ground at Sandy Hook on Dec. 10, and were continued during the week. The last shot fired was the fortieth round, with the following results: The shot was 3 calibres long; weight, 111 pounds. Nineteen pounds of slow burning powder was used in the breech and 97 pounds of quicker burning powder was distributed in the four supplemental charge chambers, making the total amount of powder used 116 pounds. The velocity of the shot was 1,942 feet per second, the maximum pressure being 30,000 pounds per square inch. The elevation was 4½ degrees. The range was 4,480 yards.

Mr. Haskell says that in the trial of the Krupp 11 inch gun the weight of the shot was 759 pounds; weight of powder, 253 pounds; pressure, 40,829 pounds; elevation, 4¾ degrees; range, 4,480 yards. He also says the full capacity of the multicharge gun has not been reached.

KRUPP, the famous gun-maker, employs 20,000 men. His whole establishment comprises the factories at Essen; three coal mines at Essen and Bochum; 547 iron mines in Germany; several iron mines in the north of Spain, in the environs of Bilbao; the blast furnaces; a range at Meppen, seventeen kilometers in length, for gunnery experiments; other smaller ranges, and four steamers for marine transport. The number of blast furnaces in use is eleven, of other furnaces 1,542. There are 439 steam boilers, eighty-two steam hammers, and 450 steam engines, of 185,000 horse-power altogether. He is now manufacturing for the Italian Government a monster gun, which will weigh 130 tons.

A GEOLOGICAL map of France, on a scale of 1 to 500,000, prepared by MM. G. Vasseur and L. Carez, will be completed in 48 sheets early next year. It is the first that has been executed since 1742. Some of the sheets have already been sent to press.

A WIRE rope has just been manufactured in the works of Sir George Elliott, M. P., at Cardiff, Wales, for the North British Railway, which is 2,300 fathoms in length, or 2 miles and 108 yards. It weighs 21¾ tons. Nearly 100,000 fathoms of wire have been used in making it. This huge rope is to be used in working the trains in the tunnel at Glasgow, between Queen street station and Cowlairs.

A PERFECTLY healthy, full grown man of 154 pounds weight will be made up thus: Muscles and their appurtenances, 68 pounds; skeleton, 24 pounds; skin, 10½ pounds; fat, 28 pounds; brain, 3 pounds; thoracic viscera, 3¼ pounds; abdominal viscera, 11 pounds; blood which would drain from body, 7 pounds. This man ought to consume per diem: Lean beefsteak, 5,000 grains; bread, 6,000 grains; milk, 7,000 grains; potatoes, 3,000 grains; butter, 600 grains, and water, 22,900 grains. His heart should beat 75 times a minute, and he should breathe 15 times a minute. In 24 hours he should vitiate 1,750 cubic feet of pure air to the extent of 1 per cent; a man, therefore, of the weight mentioned ought to have 800 cubic feet of well ventilated space.

HERRESHOFF, the blind boat builder of Bristol, R. I., has just finished a steam launch for Jay Gould's use. She is a beautifully modelled craft, intended for New York harbor cruising and to accompany the rich man's steam yacht, the Atlanta. She is nearly 36 feet in length and 7½ feet beam. In her best speeding the little craft ran up to fifteen miles per hour a speed never before attained by a steam yacht of her size. She cost over $30,000.

FOR the last two years the South Eastern Railway Co., of England, have been running a trial carriage, with the sides and roof fitted with panels, painted with luminous paint. This gives sufficient light for the day service in passing through the tunnels, and effects a very considerable saving over the oil and lampwick formerly necessary.

THE venerable Abbey of Westminister is now undergoing extensive repairs, which are to cost $250,000. It is not intended to make any radical changes, but is expected that the repairs will have the effect of improving the appearance of the building as well as of adding to the comfort of the worshippers.

A MAGNIFICENT cathedral has just been completed in Moscow, to commemorate the retreat of Napoleon from Russia. The building, which will accommodate some ten thousand worshippers, and the total cost of which has been over £2,000,000 ($10,000,000,) has been in process of construction for the last fifty years. One of its bells, it is said, weighs over twenty-six tons. The human figures on the dome are fifty feet in height.

THE height of the principal structures in the world are as follows: Washington Monument, 550 feet; Cologne Cathedral, 513 feet; Pyramid of Cheops, 495 feet; St. Peter's, at Rome, 485 feet; St. Paul's, in London, 465 feet; St. Mark's at Venice, 323 feet, and the Capitol at Washington, 283 feet.

THE charge for the passage of a ship through the Suez Canal is dependent upon the tonnage, but the average is $6,000.

DUBUQUE, Io., December 8.—The farmers residing in the vicinity of Faulhopper's Lake have undertaken a great work in the draining of the lake from its southern extremity to the Maquoketa River, two miles north, a ditch being dug at an enormous expense.

American Society of Civil Engineers.

RECORD OF MEETING.

Vice-President Joseph P. Davis in the chair. The death, on November 10th, of Mr. Gabriel Jordan, M. Am. Soc. C. E., was announced.

A Paper was read by Edmund B. Weston, M. Am. Soc. C. E., giving a description and the results of some experiments that were made to ascertain the force of water ram that could be generated above the static pressure in water-pipes under various conditions. The experiments were made at Providence, R. I.

A combination of iron pipes of different sizes and various lengths were used in making the experiments. An air chamber, 2½ inches in diameter, and 42 inches in height, that could be used or thrown out of service at pleasure, was connected to a 2½ inch pipe of the combination.

The water used was taken from a distribution pipe, which was supplied by two 24 inch mains. The quantity of water that flowed through the pipes was measured in each intance.

The force of the ram was ascertained at the different points in the pipes by the aid of a Richards steam engine indicator. The force of the ram was produced by suddenly closing a valve in the outlet pipe, and it was regulated by screwing orifices of different sizes to the outlet pipe.

The results of some of the experiments are as follows:

Force of ram generated in a line of pipe consisting of 111 feet of 6 inch, 58 feet of 2 inch, 99 ft. of 1½ inch, and 4 feet of 1 inch, which was the outlet pipe.

Orifice of discharge in inches.	Velocity in the 1 inch pipe.	Ram in pounds per square inch.						
		1 inch.	1½ inch. Distance from 2 inch. 32 ft.	49 ft.	67 ft.	6 inch.	Dead end. 2½ inch.	The same with air chamber.
3/16	2.57	72.8	72.4	70.8	70.3			
¼	5.36	129.3	125.9	127.0	123.8	14.5	18.8	
⅜	10.05	..	..	..	..	23.5	42.2	16.8
½	19.23	..	..	..	..	51.7	88.3	49.3

The dead end referred to in the above table was a continuation of the pipe beyond the point in the 6 inch, where the 2 inch was connected, and consisted of 70 feet of 6 inch, 66 feet of 4 inch, and 4 feet of 2½ inch, which was at the extremity, and located, measuring on the line of pipe about 322 feet from the orifice of discharge.

Force of ram generated in a line of pipe consisting of 111 feet of 6 inch, 58 feet of 2 inch, 48 feet of 1½ inch, 3 feet of 3 inch, 48 feet of 1½ inch, and 4 feet of 1 inch, which was the outlet pipe.

Orifice of discharge in inches.	Velocity in the 1¼ inch pipe.	Ram in pounds per square inch. 1½ inch. 16 ft. from 3 inch	Center of 3 inch.	1½ inch. 16 ft. b'y'd 3 in.
3/16	1.19	75.3	64.5	61.2
¼	2.37	126.4	120.8	113.8
5/16	3.00	150.2	150.5	138.9
⅜	4.47	209.3	206.8	195.3

Force of ram generated in a line of pipe consisting of 182 feet of 6 inch, 66 feet of 4 inch, 4 feet of 2½ inch, 1 foot of 2 inch, 7 feet of 1½ inch, and 6 feet of 1 inch, which was the out-let pipe.

Orifice of discharge in inches	Velocity in the 1 inch pipe.	Ram in pounds per square inch. 1 inch.	1¼ inch.	2½ inch.	6 inch.	With air chamber. 2½ inch.	6 inch
3/16	5.39	66.7	49.4	23.3	4.8		
5/16	6.71	78.1	61.5	35.6	6.6		
¼	10.02	106.3	81.8	52.0	15.8	14.0	12.3
½	20.94	177.5	121.5	99.0	36.8	38.7	25.6
1	43.9	..	..	183 0	80.1	105.8	65.6

A note on a method for increasing the accuracy of a system of magnetic bearings of a survey, by Olin H. Landreth, M. Am. Soc. C. E., was read. In assigning a set of magnetic bearings to a survey in which the angles have been measured, the method proposed is:

(1.) Measure and record the traverse angle at each station referred to the first line of the survey as an origin.

(2.) Observe and record the magnetic bearing of each line, taking as such the average bearings from each end of the line.

(3.) Apply the traverse angle, with its sign reversed, at each station to the magnetic bearings for the first or original line, each transferred from a separate line of the survey.

(4.) Take the arithmetical mean or average of the several values of the bearing of the first side as the adopted bearing for that side.

(5.) Apply the traverse angles, with their true sign, in turn, to the adopted bearing of the first side, giving thus the corrected bearings for each side.

Suggestions for Flattening the Ends of Rail road Curves, by Albon P. Man, Jr., M. Am. Soc. C. E., was read. The formulas given, partially adopted from Rankine, are as follows:

For speed of 40 miles per hour, the length of the adjustment curve equals 25 to 30 times the degree of curvature (the sum of degrees if reversed curves, the difference if compound). Taking this length at a convenient even number of feet, the shift for each curve will be 8 times the square of the length of the adjustment curve, multiplied by the degree of curvature, divided by 1-100000.

The deflection distance of the adjustment curve, at any point, distant (x) from the end of the adjustment curve, will be $4x^3$ multiplied by the shift, divided by the cube of the length of adjustment curve:

Or a, being length of adjustment curve.
c, " degree of curvature.
s, " shift.
d, " deflection distance.
x. " distance of deflection point from end of adjustment curve.

$$a = 25\,c \text{ (or } c + c^1\text{, or } c - c^1) \qquad (1.)$$

$$s = \frac{8\,a^2\,c}{1\,100\,000} \qquad (2.)$$

$$d = \frac{4\,x^3}{a^3}\,s \text{ (or } s \pm s^1 \qquad (3.)$$

Tables prepared upon the above basis accompany the paper, with rules for their application.

Dec. 3, 1884, a communication from the Civil Service Commission of the State of New York was presented, requesting a conference in reference to standards of qualification for the several grades of engineers and their subordinates employed by the State. The communication was referred to the Board of Direction with power to act.

A collection of samples of building materials used in ancient Rome, presented to the Society by Sig. Felice Cicconetti, a disinguished architect of Rome, was exhibited.

A paper by A. M. Wellington, M. Am. Soc. C. E., upon Experiments with New Apparatus on Journal Friction at Low Velocities, was discussed. The paper and discussion will be published immediately in Transactions.

JOHN BOGART,
Secretary Am. Soc. C. E.

December 19th, 1884.

Liverpool Engineering Society.

The last annual general meeting of this society was held at the Royal Institution, Colquitt street, Liverpool. Mr. R. B. Bevis, Jun., president, in the chair. On the conclusion of the ordinary business and the election of officers for the ensuing year, the president delivered his retiring address. Some of the local events of engineering importance were first considered—particularly the Mersey Tunnel and the Manchester Ship Canal. The fact was referred to that it was only in the early part of this year that a practical hope was given of the speedy realization of the project, and as the work is now approaching completion some of the possible changes and developments likely to follow where also remarked upon.

With regard to the Manchester Canal, it was observed that even in its lately submitted form, and apart from all consideration of its ultimate commercial success, it, at all events, would have the merit of providing a large amount of work during its construction.

Recent developments of ocean steam navigation were next dwelt upon, and the introduction of fast steamers exclusively for passengers, when they became the most important and lucrative portion of the traffic. The system of forced draught recently introduced into her Majesty's service, and, and, in a few instances into mercantile vessels, was described, and it was remarked that the results in her Majesty's ships could so far hardly be considered satisfactory when the cost of applying the system was taken into account, though it would always afford a means of maintaining steam when the boilers became, from one cause or other, less efficient with natural draught, and would also cause thorough ventilation. Particulars of the increased combustion obtained were given.

Some modifications which have been made in the ordinary compound engine since its practical introduction was next dealt with, as also the question of the weight of machinery with reference to its probable further reduction. The introduction of the triple expansion engine had already led to a slight increase of trade, especially on the east coast, where about twenty-five sets have been made during the past year. This engine, with its three cylinders in a line, each with its own crank, was undoubtedly, from a mechanical point of view, the best engine of the day; on very good authority, and in a case where careful comparison with the ordinary compound engine could be made, a saving of over 15 per cent. in consumption of fuel was stated to have been effected by the use of triple expansion. If one-fourth of the mercantile marine were so fitted, the saving, based on the present rate of consumption, would be about 350,000 tons a year. The latter portion of the address was devoted to matters more particularly relating to the society.

The president congratulated the members on its continued success, and stated that during the past session eleven papers had been read and discussed at the ordinary meetings, and that no less than six excursions and visits had been made. Three of these, viz., those to Warrington, where the method employed to deal with sewage was examined, to Manchester to test the working of Mr. Holroyd Smith's electric tramway and to Wigan for the purpose of becoming practically acquainted with Mr. William Wilkinson's new "worm-geared" tramway locomotive, were in a sense illustrative of papers read before the society. The other excursions had been to Stoke-on Trent to visit the well-known works of Messrs. Wedgwood and Sons, and Messrs. Minton & Co., to Vyrnwy to inspect the works in connection with the new water supply of this city, and to Festiniog to examine the underground slate quarries of Mr. J. E. Greaves.

In conclusion, an earnest wish was expressed for the future welfare of the society. A hearty vote of thanks to the president brought the proceedings to a close.

WE now have 5,000,000 souls more than the 50,000,000 we had at Garfield's death. This vast multitude of people have all got to be fed, clad and sheltered. With a steady limitation of production in many directions we have had an enormous increase of consumers; and the first thing we know the surplus will have disappeared, and there will be a short stock of everything but virtue, followed by a revival of trade.—*Age of Steel.*

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PHILADELPHIA is debating the means whereby she can borrow one million dollars urgently needed for permanent improvement; notably for the proposed Market St. Bridge.

According to the new Constitution of 1874 the city debt can not exceed 7 per centum of the assessed valuation of taxable property within the limits of the municipality. In August last this assessed valuation was $597,785,428, and the gross funded debt on Jan. 1, 1885 will be $64,162,791.24.

But the Commissioners of the Sinking Fund will at the same date hold securities and cash representing $23,857,775, and the question now arises as to the manner in which the term "indebtedness" should be legally defined. By deducting the sinking fund assets from the gross debt, there would remain a net funded debt of $40,311,016.24, which does not reach the debt allowable, at 7%, by over one and a half millions of dollars, leaving the latter sum disposable. The discussion is a lively one, the authorities being about equally divided in their opinions.

THE suggested change in the manner of holding the Annual Conventions of the American Society of Civil Engineers, is a step in the right direction. In late years, each succeeding Convention has developed a more elaborate and expensive programme of entertainment on the part of the local committee and its friends, until this feature has become a burdensome tax upon these gentlemen, and has seriously interfered as well with the more important purposes of the Convention.

As we have remarked before, the one great end to be attained by these annual meetings is the opportunity presented for the social and professional intercourse of a widely scattered membership; they can there meet and know each other, both as engineers and as men. It is this spirit of fellowship that is most likely to promote the growth of the Society and extend its field of usefulness; and the change suggested by the Board of Directors, is intended to bring the members still more intimately together.

The time at the disposal of engineers, attending the Convention, is too valuable to be expended on mere junketing excursions to points of little or no engineering interest, or in eating dinners and lunches paid for by strangers. While we must all recognize the spirit of hospitality which prompts this entertainment, the Society as a body would be benefited by a more independent action; by paying its own way, and selecting for itself places to be visited and the points of interest to be examined. It should be untrammeled in its movements by the wishes of others or the sense of obligation for favors received.

The discussion of professional matter and the "Shop-talk" of engineers is after all the thing most interesting to the men assembled, and should be first attended to. But these meetings must not become tedious or dull; the Conventions must not be made so very good, professionally, that they are good for nothing. We believe that the interests of the Society would be advanced by a change in the manner of presenting papers at the Annual Conventions, as well as in the other features of these meetings. And in this connection we would recommend that all lengthy and purely technical papers be regularly printed in the Transactions, *before* the date of meeting, and read only by title at the meeting. No man can intelligently discuss the points of a scientific paper on merely hearing it read to him, indistinctly perhaps, in any event under circumstances not conducive to a proper digestion of the subject matter. That his expressed opinions may be of real value, he must have time to study it in all its points, and leisurely compare it with his own experience or that of others. Time, too, would be saved for the more animated personal discussion among the members present, a class of talk rarely dull or uninteresting.

As to entertainment, other than the reading of papers, and there should be something else we think we could trust to the versatile ability of the American engineer to provide it in an acceptable form.

THE sudden awakening of the Nicaraugua Canal Scheme, after its slumber of some years, will probably lead to a more thorough and intelligent survey of the country to be traversed. As yet all estimates of cost are based on very imperfect data. We will add to our geographical knowledge, if not to our commercial supremacy.

The New Croton Aqueduct.

The Board of Aqueduct Commissioners, on Saturday Dec. 13, awarded the contracts for the aqueduct from Harlem River to the Croton Dam, a total distance of 148,692 ft., for the round sum of $11,890,322. The successful bidders were as follows:

Section A—Heman Clark, New York	$1,051,675
Section B—Heman Clark, New York	1,096,065
Section 9—O'Brien & Clark, New York	1,333,237
Section 8—O'Brien & Clark	1,157,285
Section 7—O'Brien & Clark	1,376,765
Section 6—O'Brien & Clark	578,140
Section 5—Brown, Howard & Co, Chicago	726,975
Section 4—Brown, Howard & Co	1,518,475
Section 3—Brown, Howard & Co	1,398,050
Section 2—Brown, Howard & Co	1,653,655
Total	$11,890,322

The security required is 10 per cent. of the Engineer's estimate, or $1,428,000, and work must begin 10 days after the bonds are approved and be completed within 33 months. The section of work under and south of the Harlem River will be let at a later date.

To enable our readers to make their own comparisons we reprint in this issue the total bids by sections, and also a sheet of detail prices as bid for a selected, typical section showing the varying estimate of cost as fixed by individual bidders.

According to a strict digest of the bids, the firm of Brown, Howard & Co., of Chicago, should have had the whole work, as being the lowest general bidder, and the city would have saved a considerable sum of money; but, as explained to the press, the Commissioners believed that the work would be done more rapidly and better by splitting it up and they accordingly made an arbitrary division as stated above.

Heman Clark was interested with John F. Ward, of Jersey City, in the building of three sections of the Sudbury River additional water supply for the City of Boston, and subsequently constructed 800 miles of the North Pacific Railway under the Villard administration. He is at present a Director in the Louisville and Nashville R. R., and is reputed to be a man of great wealth; he is a member of the firm of O'Brien & Clark, another of the successful bidders. Mr. John O'Brien was a contractor on the West Shore Railroad, and is now constructing the Sideling Hill Tunnel on the South Penna, R. R. The firm of Brown, Howard & Co., of Chicago, is made up of Columbus Cummings, of Chicago, Walston H. Brown, of New York, Wm. B. Howard, George Chambers, A. J. McBean and D. D. McBean, all of Chicago, excepting the last who is from Portland, Oregon. Brown, Howard & Co., built the Nickel Plate R. R., the firm being organized for that purpose. Geo. Chambers is an extensive builder and contractor of Chicago, and was engaged with the celebrated English contractor, Brassey, in tunnel building in France. The Messrs. McBean built the La Salle St. Tunnel in Chicago, and the Detroit Tunnel, as far as completed, the Siskiyou Tunnel in Oregon and other extensive works on the O. & C. R. R., among others the Snake River Bridge.

At the same meeting the Aqueduct Commission raised the salary of Chief Engineer Benjamin S. Church, from $6,000 to $10,000 per annum.

Report of the Department of Public Works; New York.

Hubert O. Thompson, Commissioner of Public Works, has made his report for the quarter ending Sept. 30, from it we make the following abstract:

The total expenditure for the quarter was $1,222,052.62, and the total for the nine months ending Sept. 30, was $3,125,312.52; 64 contracts were entered into in the quarter, amounting to $627,729.04, and 38 contracts were completed in the same time at a total cost of $457,409.46.

From the Chief Engineer of the Croton

Aqueduct, the following matter is reported:—Average total rainfall for July, August and September, at the five department stations, was 13.42 inches.

The abundant rainfall in July and August filled the two storage reservoirs and the lakes, from which 520,000,000 gallons of water had been drawn in June, but early in September dry weather set in, and by the 15th of September the natural flow of the Croton River fell below the amount required to keep the Aqueduct running to its full capacity, making it necessary to draw again upon the stored water. The amount drawn to the close of the quarter is as follows:

From Boyd's Corners Reservoir	250,000,000	gallons
From South East Reservoir	240,000,000	"
From Lake Mahopac	100,000,000	"
From Lake Gilead	30,000,000	"
From Lake Gleneida	40,000,000	"

The Bronx River supply was completed on Sept. 4, by the laying of the 15⅛ miles of 48 in. pipe leading from the collecting reservoir at Kensico to the receiving reservoir at Williamsburg, and 2½ miles of 36 in. pipe around the latter reservoir and thence to Jerome Avenue. After the repair of two breaks, caused by rock blasting, the water was turned on to the 23rd and 24th Wards distributions on Sept. 9, and 10,000,000 galls. per day since supplied. The effect of this addition to the general supply was to increase, by Sept. 30, the depth of water in the new Central Park Reservoir by 3 ft., and in the old or smaller reservoir, by 11 ft., and in the 42-Street reservoir, 8 ft. At the same time the pressure on the distributing mains throughout the city was increased an average of 8 ft. in height, with a strong probability of a gain of 12 ft. as soon as the dry season has passed. Mr. Geo. W. Birdsall, First Asst. Engineer of the Croton Aqueduct is commended for the promptude and success with which the project has been carried out. All the work, upon the Bronx system is not yet completed, some further labor is still required on two sections of the conduit line and on the Kensico reservoir.

During the quarter 718 additional water-meters were placed, making a total of 10,836 meters in service on Sept. 30. The inspectors on water waste made 3,238 night examinations in sewers, and detected 334 house connection wastes of from one to five gallons per minute. The inspectors also made 7,001 house inspections resulting in the detection of 2,118 plumbing and water fixture leaks, and 180 cases of wilful waste in leaving faucets open. About Sept. 1 the necessary arrangements were completed for applying the waterphone to the service pipes of each house in 45th, 46th, 47th, and 48th-Streets, between 5th and 6th Avenues. In the little time elapsing a saving of 20 % in the use of water in these blocks is already reported.

The following amount of revenue from the water service was collected and paid into the City Treasury during the quarter:

For water rents	$854,481.77
For penalties on water rents	2,827.85
For permits to tap water-pipes	2,794.50
Total	$860,104.12

Commissioner Thompson speaks as follows of Isaac Newton the late Chief Engineer of the Croton Aqueduct:—

"Equipped with splendid talents and learning, his largeness of view and correctness of judgment, his energy, zeal and devotion in the performance of every charge intrusted to him, made him the peer of the foremost men in his profession, and competent to master any engineering problem presented to him, of whatever magnitude.

The best proof of this is in the fact that in less than two months after entering upon his duties as Chief Engineer he had so thoroughly studied and mastered the great subject of an additional water supply for the city that he could present to me in definite form the plan for the new aqueduct, reservoir, etc., which afterward received the approval and commendation of the very highest engineering authorities in the country, and which, after more than three years' further investigation and deliberation, has been adopted as the best plan for an additional water supply.

Such a result could only be accomplished in so short a time by the ceaseless attention, study and labor which were Mr. Newton's most prominent characteristics, and which he exhibited to such an extreme that from time to time he exhausted his physical powers to the verge of endangering his life. He not only devised the main features of the New Aqueduct plan, but every detail of it.

For this work alone his name should forever be gratefully remembered by the people of the city."

Stevenson Towle, Engineer in charge of Sewers, reports the total present length of sewerage in the city, 2,171,633 lin. ft. (411$\frac{18}{100}$ miles), with 5,015 receiving basins.

The expenditure for "Lamps and Gas and Electric Lighting," for the quarter, was $167,919.63; and for the nine months ending Sept. 30, it was $496,850.71. The total number of the electric lamps in service is 647, of which 347 are supplied by the British Electric Illuminating Co. and 300 by the United States Illuminating Co.; the total number of gas lamps on Sept. 30 was 22,707.

The American Society of Civil Engineers.

The Thirty-second Annual Meeting of the Society of Civil Engineers will be held in New York on Wednesday, January 21, 1885, at 10 A. M., at the house of the Society. The annual reports will be presented, officers for the ensuing year elected, time and place of the next Convention considered, and reports of the standing committees presented.

The programme for January 22nd, including visits to points of interest about New York, has not yet been definitely fixed upon.

The Nominating Committee, appointed at the last Convention, have presented the following list of candidates for the several offices:

President: Frederic Graff. *Vice-Presidents:* George S. Greene, Jr., Thomas I. Whitman. *Secretary and Librarian:* John Bogart. *Treasurer:* J. James R. Croes. *Directors:* Theodore Cooper, William R. Hutton, Walter Katte, O. Chanute, F. A. Vaughan.

The officers to be selected are, one president, two vice-presidents, a secretary and librarian, and five directors.

One of the subjects for consideration in the coming Annual Meeting will be that of some modification in the manner and place of holding future conventions. The experience of the last few years has developed several undesirable features in these meetings, among them the following: Insufficient time given to the presentation and discussion of professional papers; too much time taken up in the local visits to points of little general interest by the Convention as a body; and the impropriety of heavily taxing resident members of the Society and others for entertainment and excursions more elaborate in character than is necessary for the full enjoyment of members and visitors.

The Board of Direction suggests the trial of a different method in these Conventions, and advises that they be held, in the future, neither at a large city or on the invitation of local members, but rather in such place where all can be accommodated and where the Convention can be managed entirely in accord with the objects which make these Conventions desirable.

It is believed that these objects are: "The presentation, consideration and undisturbed discussion of professional subjects; the opportunity for free intercourse between members of the Society, gathered at the Conventions from all parts of the United States, and in fact of the world, and such opportunities for social recreation as may not interfere with, but rather aid in, the two objects mentioned above."

The new departure, thus outlined, results directly from the expressed dissatisfaction of a number of the members of the Society with late Conventions.

BOSTON SOCIETY OF CIVIL ENGINEERS.—At the meeting of Dec. 17, interesting papers were read; by Maj. C. W. Raymond, on "The Anchorage Capacities of Harbors of Refuge," and by A. E. Burton, on "The Quincy Granite Railway."

Ohio Surveyors and Civil Engineers.

The coming annual meeting of the above flourishing society promises to be most interesting. It will be held at Columbus, January 13th to 16th next. A very attractive list of papers are already secured, besides some others are promised. Chief Engineer M. J. Becker, of the P. C. and St. L. R. R. contributes a paper on "Plate Girders;" R. F. Hartford, of Columbus, "Transmission of Power;" R. S. Weitzel, Logan, O., "Land Description;" J. L. Culley, Cleveland, O., "City Surve Notes and Plats;" E. B. Opdycke, Bryan, O., "Data and Methods of Making Estimates and Calculations on Ditch Construction;" B. J. Ashley, Mt. Gilead, O., "Sanitary Arrangements in Public Buildings at Mt. Gilead, O.;" G. R. Gyger, Homesworth, O., "Use of Solar Compass in Land Surveys."

Written reports by committees having under consideration, various matters pertaining to Civil Engineering, Highways, Drainage, Land Surveying, etc., will also be presented.

The most of these papers will be published in ENGINEERING NEWS; the Report for 1884 is exhausted; the demand exceeded the supply, and it will be advisable for parties wishing to obtain the Report for 1885 to make early application to Secretary Benj. Thompson, Urbana, O., as it is probable that the edition will be limited as heretofore. Every Ohio surveyor and engineer will be benefited by attended this annual meeting.

PERSONAL.

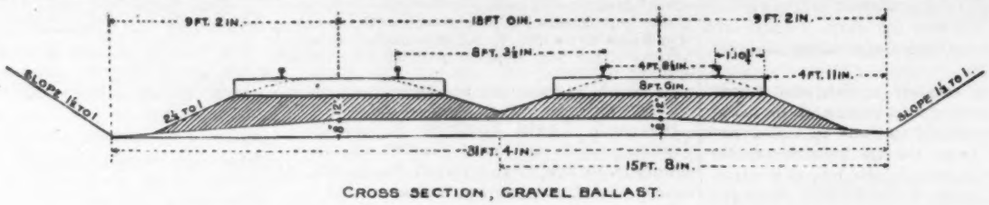
MR. JAMES F. FURBER, heretofore General Superintendent of the Boston and Maine Railroad, has been appointed General Manager of that company, with headquarters at Boston.

COMMODORE T. R. FRANKLIN, at present Superintendent of the Naval Observatory, is to be given command of the South Atlantic Station at an early day. Orders have been issued for him to prepare for sea service. It is not yet known who is to succeed him at the Observatory.

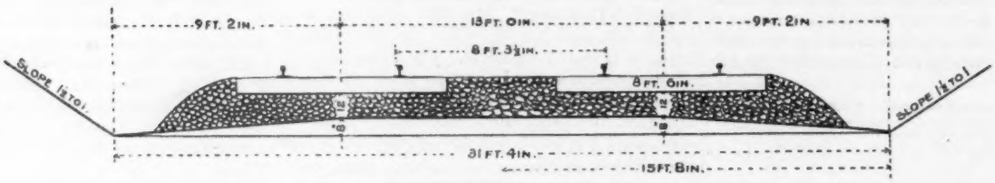
LIEUTENANT HOLM, now exploring East Greenland, is now supposed to be in winter quarters as far North on the East Coast as he was able to journey last summer. He has been absent two years and is expected to return next June with rich additions to our now comparative meagre knowledge of East Greenland.

ISAIAH B. PRICE, Professor of Mathematics at Union College, died Dec. 10, at his residence in Schenectady. PROF. PRICE was born in Newmarket, Va., of Quaker parents. He was educated at Union College and the University of Edinburgh. After completing his studies he was made tutor of mathematics at Union and in 1877 succeeded Dr. Jackson as Professor. "Price's Trigonometry" is now used as a text book at the college. PROF. PRICE was a member of the Psi Upsilon fraternity.

WILLIAM MILLER ALLAIRE, who died Dec. 14, of pneumonia, was born at Lewisborough, Westchester County, in 1854. He entered the College of the City of New York and passed through the sophomore year in that institution. His fondness for mechanics then led him to enter the Troy Polytechnic School, where he was graduated in 1876, with the reputation of being among the first scholars of his class. Upon leaving the Polytechnic School he was engaged in various engineering pursuits. He went to Egypt with Commander Gorringe and had entire charge of the obelisk from its arrival in New York until its erection. He was elected a Junior of the American Society of Civil Engineers on March 2. 1881, and at the time of his death was the engineer of the U. S. Electric Lighting Co., of New York.

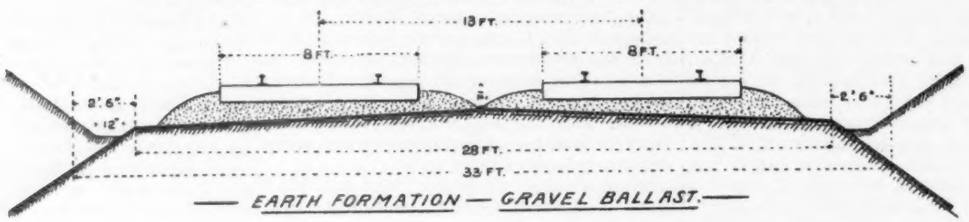


CROSS SECTION, GRAVEL BALLAST.

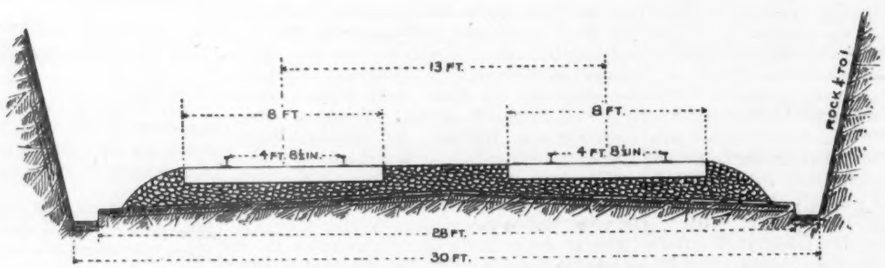


CROSS SECTION, BROKEN-STONE BALLAST.

FIG. 33.*—STANDARD DOUBLE TRACK CROSS SECTION. N. Y., L. E. & W. R. R.



— EARTH FORMATION — GRAVEL BALLAST. —



— ROCK FORMATION — STONE BALLAST. —

FIG. 34—STANDARD DOUBLE TRACK SECTION N. Y., WEST SHORE & BUFFALO R. R.

LITERATURE.

The Architect's and Builder's Pocket-book of Mensuration, Geometry, Geometrical Problems, Trigonometrical formulas and tables, Strength and Stability of Foundations, Walls, Buttresses, Piers, Arches, Posts, Ties, Beams, Girders, Trusses, Floors, Roofs, etc. In addition to which is a great amount of condensed information: statistics and tables relating to Carpentry, Masonry, Drainage, Painting, and Glazing, Plumbing, Plastering, Roofing, Heating and Ventilation, Weights of Materials, Capacity and Dimensions of noted churches, theatres, domes, towers, spires, etc., with a great variety of miscellaneous information. By FRANK EUGENE KIDDER, C. E. Consulting Architect, Boston. Illustrated with 408 Engravings, mostly from original designs. New York: JOHN WILEY & SONS, PUBLISHERS.

The author of the above work has taken as his model the well known Pocket-book of Mr. Trautwine, and proposes to do for the architects and builders what Mr. Trautwine has done for the civil engineers, in giving them a reference book, a compendium of practical facts, rules and tables presented in a handy form. He has certainly succeeded in gathering a vast mass of information useful to the class for which it is intended; and while it is mainly a compilation—as are all Pocket-books for that matter,—his selections have been made with judgment and he gives generally unquestioned authority. Like the work upon which it is founded, Mr. Kidder sacrifices theory to practice by giving only enough of the former to render the application of the rule apparent, and to outline the principles upon which the formulas are based.

The book should serve an excellent purpose in the gathering together, as it has, of so much valuable and useful information from a multitude of sources and putting them in an accessible shape for ready reference; and we have no doubt that the architects and builders of this country will appreciate the author's labors.

TRACK.*

BY W. B. PARSONS, JR., C. E.
ROADMASTER SUSQUEHANNA DIVISION ERIE R. R.

(*Continued from page 284.*)

Fig. 34—gives the standard of the N. Y. West Shore and B. R. R. whose principal item of difference from the other examples is that the gravel ballast is carried half way up the tie ends. This might be permissable in perfectly screened gravel whose characteristics are similar to broken stone.

On some roads it is the practice to shape the gravel ballast in the same manner as we have represented proper method for stone, claiming for it:

First—*Line*: Track keeps in better line since ties are held laterally.

Second—*Frost*: Frost is prevented from getting under the ties.

Third—*Protection*: Ties are better protected in case of derailment.

Of these reasons the first two are fallacious and the third does not carry the weight it seems to, besides being more than counterbalanced by the advantages of the "slope system" as the method here advocated can be called. With this system the rainfall is at once collected on the whole road bed and carried directly into the proper channels, while by filling in between the track and on outside the water is prevented from running away and has to be disposed of by the slow process of absorption; the ballast thus is kept wet for several days after a rain, letting the joints settle, preventing track work, and instead of keeping track in line really does not do as well as when the tie ends are left bare, because when the ballast is wet the co-efficient of friction between it and the tie is much reduced and the track slides laterally so much easier.

The second reason might be to a certain extent true, provided the ballast were perfectly dry, but since winter is always preceded by, and accompanied with wet weather, that track which is best drained and driest must suffer the least. With double track when center is filled in, each track on both sides is differently affected by frost on account of unequal filling; secondly, the mass of ballast lying between the tracks expands and throws both tracks out of line. These troubles are avoided by the "slope system" which is thus superior to the "filled track" on the question of "frost" as well as "line."

The third reason is the only one of strength, which however has far less weight in practice than in theory.

Opposed to such a method are all the advantages of the "slope system" previously enumerated, together with a great saving in material and especially in labor of maintenance, for the track can be more readily lined in either direction, at least 8 per cent. more ties can be put in with same labor, while on account of its drying quicker after a rain it not only stays in surface better, but permits more working days.

(TO BE CONTINUED.)

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*In our issue of last week Fig. 33 was incorrectly illustrated, we now give the proper cut.

ENGINEERING NEWS for Three months One Dollar.

Losses of Mail.

The Post-office Department received 4,127 inquiries relative to foreign registered letters, making a total of 8,365 complaints concerning the registered mail received during the last fiscal year. Of the complaints investigated actual loss was found to have occurred in 516 cases. Assuming the proportion of loss to be as great in the complaints still undergoing investigation as in those investigated, the total loss occurring during the fiscal year in the registered mail is approximately 672 pieces. Comparing this with the total number of pieces registered—11,246,545—the proportion of loss will be seen to be very small. The losses were from all causes, as burning and robberies and other unavoidable casualties. The amount of money recovered and returned to the owners in 772 registered cases was $17,932. Complaints were received of the loss of 20,377 ordinary letters, of which 14,641 were said to have contained inclosures; 12,078 ordinary packets (fourth class) were reported as lost. Upon investigation 1,809 letters and 1,101 packets were found to have eventually reached their destination or were otherwise satisfactorily accounted for. Four hundred and sixty-seven post offices were robbed, 278 destroyed by fire, 23 highway robberies of mail were reported, and 24 postal cars were burned. The miscellaneous cases numbered 4,870. They were of a confidential nature, and resulted in the collection from delinquent post-masters and others of money, fines, and penalties aggregating $26,927. The whole number of foreign cases of loss reported was 7,634, more than 1,300 originating with Great Britain and nearly 1,400 with Germany.

CORRESPONDENCE.

Willow Roots in Drain Pipes.

Special Correspondence Engineering News.

CENTRAL PARK, NEW YORK, DECEMBER, 13th, 1884.

EDITOR ENGINEERING NEWS:—Having frequently in my practice found drains obstructed with roots of trees, I will describe one laid in Madison Square, and give the remedy applied to prevent roots from penetrating pipes, hoping it will be of interest to some of your readers.

There are several varieties of trees, that extend their fibrous roots a long distance in search of moisture usually present in drains, and among them I have particularly noticed the following, viz.: Silver leaved maple, *Acer descarpum*; Red Maple, *Acer rubrum*, Elm, *Ulmus Americana*. The willow family causes more trouble than any other variety, and next in order is the Elm family. In October last when removing a tile drain in Central Park I found the roots of a tree called *Paulownia imperialis*, which resembles the catalpa, growing in it for fifty-six feet. One-third of the length of this root was three inches in diameter, having broken a tile that was two and one-fourth inches in diameter in which it grew; the remaining two-thirds being nearly large enough to fill the tile. The small end of this root was not pointed but circular in form, four inches in diameter and one and a half inches thick. I could discover no cause for the end to assume a circular form instead of a pointed one.

In 1871 a vitrified drain pipe eight inches in diameter for surface drainage only, was laid under my direction in Madison Square; located from seven to fourteen feet distant from white willow trees, *Salix alba*. The mortar used in making up the joints of the pipe when laid was composed of equal parts of Rosendale cement and sand. Three years after, in 1874, this drain pipe was found to be partially obstructed; and an effort made to force an opening with stiff wire met with only partial success. The following year the pipe was taken up and found completely filled with fibrous roots growing from the willow trees; and so compact had the mass of roots become that a horse attached to one end removed a piece sixty feet long. The roots composing this mass varied in size from one-sixteenth to one-fourth of an inch in diameter; and the proportion I found to be as follows: fibers one-sixteenth of an inch in diameter composed thirty per cent; fibers one-thirtieth of an inch in diameter sixty per cent; fibers one-fourth of an inch in diameter four per cent. The mortar used in cementing the joints of this pipe was in perfect condition, and no cracks were discovered to allow the roots to enter the pipe, but a closer examination revealed the mystery. The fine fibres, one-sixtieth of an inch in diameter, had grown through the solid mortar, and increased within the pipe to the size and length described.

This drain was then relaid with similar mortar joints, but the roots still continued to obstruct the pipe, making it necessary to remove it in 1877-1879 and 1881.

When this drain was relaid for the third time, in 1881, I recommended bituminous paving cement, to be applied to the joints after having been prepared in the usual manner with mortar, to prevent if possible further trouble from roots; but they obstructed the drain for the fourth time the present season, and when the pipe was removed, about twelve feet of it was found filled with roots which entered at only a few joints, where the mortar had been imperfectly covered by the cement with a thin coat painted over the mortar joints. Wherever the cement was soft the roots grew through it but were killed; wherever the coating of cement was only one-eighth of an inch thick but hard, it killed the roots but was not penetrated by them. I tested roots that grew through the soft cement with a microscope, and also placed them in water of a mild temperature where they remained for two weeks without any sign of vitality appearing.

This drain was relaid again in July last and I then treated it in a thorough manner with a bituminous concrete, which will now be described. When relaying the pipe this season the sockets only were filled with mortar, in order to present as little mortar surface as possible to be covered with the concrete, preferring to apply the concrete on the glazed surface of the pipe rather than on the mortar. The bituminous concrete was composed of N. Y. Coal Tar Chemical Co. Paving Cement, known to the trade as No. 5, mixed with fine gravel. No. 4 Paving cement and fine sand would have been preferable. The proportions used being seven gallons of paving cement to forty cubic feet of fine gravel. This proportion should be varied according to the fineness of the gravel or sand. The paving cement and gravel were heated separately to about 220° Fahrenheit; then thoroughly mixed and applied at a temperature of 200° Fahrenheit. Before applying this mixture the pipe was painted with crude coal tar without heating, to make the concrete adhere more readily to the pipe. The tar can be applied with a brush or rag tied on a stick. The concrete was then put on around the joints not less than three inches in thickness, extending four inches each way from the ends of the hubs, covering the surface at each joint eight inches longitudinal of the pipe, the ground having previously been dug away from under the joints and pipe for less than three inches. This concrete was packed thoroughly around the pipe by ramming with wooden rammers. Great care should be taken to pack the concrete thoroughly while warm. No filling of the trench should be done until after the concrete has become hard. This concrete was applied to the drain for seventy feet with manholes at each end to enable it to be readily examined in the future.

The partial success obtained in the first imperfect trial has induced me to believe that the latter experiment will be successful; and also that the carbolic and cresylic acids, napthaline and the bassic oils contained in the paving composition, when applied in the manner described, will effectually prevent the ingress of any roots into drains. Time will determine whether my conclusions are correct.

Yours very truly,
F. A. CALKINS,
M. Am. Soc. C. E.

WATER.

UTICA, N. Y., will erect a new reservoir of about 500,000,000 gallons capacity.

IT is expected that water-works will soon be built at Milan, O.

IT is expected that water-works will be erected at Escanaba, Mich.

SAYRE and Athens, Pa., are now supplied by the Sayre water-works.

BUCHANAN CITY, Mich., is bound to have water works if the same shall cost as much as $6,000.

SAGINAW, MICH., a city of 30,000 inhabitants, has fourteen and a half miles of sewers.

THE water supply for the buildings of the New Orleans exposition is obtained through Worthington pumps, giving 4,000,000 gallons per day.

REPRESENTATIVE NELSON of Minn., is working hard to push his bill authorizing the Mississippi River water power and boom company to construct a dam at Brainerd.

THE Calumet Sewer Pipe Works, two miles north of Toronto, Ohio, were destroyed by fire Dec. 14. The works were the largest in the country, and the loss is estimated at $100,000, on which there is an insurance of $40,000. The Company will rebuild.

THE Chicago City Council has taken up the question of an enlarged water supply system, and a proposition is now pending to expend $20,000 in employment of three experts to report the most feasible plan for adoption by the city.

IN the Supreme Court of California, a recently filed opinion states that the City and County of San Francisco are liable for damages caused by the discharge of a public sewer, even if it was part of a plan adopted by the board of supervisers that such sewer should be left open at the places through which its contents flowed.

AN exchange says that when the drill struck the granite in boring an artesian well near Atlanta Ga., the thud of the ponderous instfument could be heard at Clarkston, ten miles away. A ledge of rocks of the same formation crops out in the town, which transmits the sound of the falling drill.

MINNEAPOLIS is exercised over a pollution of its water supply. The City Engineer, Mr. Andrew Rinker, denies that the sewer discharge has any bad effect upon the water, but believes the trouble comes from Bassett's creek, if it really exists. The Superintendent of the water-works charges the mischief to the Union Depot Sewer. The subject is to be investigated.

THERE has been less rain in the South this Fall than for the past thirty years, which fact has produced a not large, but very clean, cotton crop. For the ninety-seven days succeeding the 28th of August last, less than one inch of rain fell in the state of Georgia. As a consequence, wells and springs are drying up and distress is beginning to be felt.

THE Pullman, Ill., sewage farm, with its downward intermittent filtration system, has now been in operation three years. A late report shows a decided increase in all the products. About forty farm hands are employed and the yield for 1883 paid 8 per cent on the investment; that for 1884 was larger still, but the average prices received for produce were less. The managers say there is no question about the success of the scheme.

WATER-PIPE CONTRACT.—At Pittsburgh, on the 4th inst. bids were opened for furnishing special casting and 12, 15, 16, and 20 inch water-pipe to be used in extending water to the Southside. Five bids were received, the lowest being that of the Cincinnati and Newport Iron and Pipe Company. Their proposition was to furnish all the pipe at $24.20 per ton, and the castings at $50 per ton. The contract will amount to about $35,000, independent of laying the pipe, and the distance to be traversed is 14,400 feet.

THE Minneapolis *Tribune* gives the following list of rates for metered water per 1,000 gallons:

	cts.		cts.		cts.
Meriden, Conn	10	Providence R. I.	20 to 30		
Boston, Mass	20	to 30	Pawtucket, R. I.	06 to 30	
Lawrence, Mass.	20	to 20	Portland, Maine	30 to 50	
Taunton, Mass.	12½	to 25	Oswego, N. Y.	20 to 40	
Springfield, Mass.	15	to 30	New London, Conn.	20 to 30	
New Bedford	12½	to 15	Hartford, Conn.	16 to 30	
New York City	20	to 35	New Britain, Conn.	10 to 30	
Albany, N. Y.	10	to 40	Jersey City	10 to 20	
Newark, N. J.		to 15	Burlington, Vt	20 to 50	
New Haven, Conn.	15	to 30	Dayton, Ohio	15 to 50	
Worcester, Mass.	15	to 30	St. Paul, Minn	25 to 50	
Utica, N. Y.	25	to 50	Cincinnati	15 to 15	
Titusville, Penn.	12½	to 30	Detroit	20 to 20	
Syracuse, N. Y.	20	to 40	Brooklyn	25 to 25	
Schenectady, N. Y.	20	to 50	Minneapolis	10 to 20	
Rochester, N. Y.	10	to 50			

THE City of Salem will petition the Legislature for the right to lay a new supply 20 inch pipe from the reservoir in Beverly, through Beverly under the Danvers River, by syphon, and through North Salem, to a connection with the present service in North St.

The City is now dependent on a single pipe which passes under the channel at Beverly Bridge by a syphon, and the authorities do not deem it safe to trust to one pipe, as that is in an exposed position between the R. R. and county bridges. The cost of the new line is estimated at $130,000 for the route crossing the river by syphon, or $200,000 by the way of Danvers at the head of navigation.

The City of Salem and Town of Beverly have not yet settled upon the price to be paid the former for the use of Wenham Water for the next five years. The old contract expires this month, and something will have to be done soon. Beverly complains that $11,000 per year is too much for the service, and asks for 90 lbs. pressure instead of the present 50 lbs., but Salem says that Beverly pipes will not stand the increased head. There is some talk in Beverly of giving up the present arrangement, and building a separate reservoir, etc., independent of the Salem pumping works. The project will probably be brought up at the next annual Town Meeting in March 1885.

The contract for supplying Oswego N. Y. with water from the river, expires in 1888, and negotiations are now pending for a renewal of contract. For 16 miles of pipe (mostly 3 inch and 4 inch, with one 6 inch, and one 8 inch pipe) and 100 hydrants, the company were to receive $20,000 per year for 20 years.

For extensions they received in 1883 the interest at 7 per cent. on reported cost	$3,818.23
Extra Pressure	$150.00
For Public Water Troughs	$1,487.50
Total	$25,455.71

The City has the option of taking these works at original cost plus, 20 per cent. Sixteen aldermen, and the mayor represent the City, also an Advisory Committee of twenty-two citizens have been appointed by the mayor.

The cost of the works is not publicly known, and owing to so much small pipe their fire efficiency is not satisfactory, and some object to the quality of the water. Many of the citizens are anxious to have the supply taken from the Lake, and think that a less expenditure annually, ought to give a better and more

efficient water supply. Hon. A. S. Page, ex-member of Assembly, and Ex-mayor has taken considerable interest in the improved water supply.

Sub-Committees of the Advisory Committee have been appointed, and while some of them are so abundantly supplied with information and wisdom, that the construction of water-works is a mere bagatelle, some of the other members are anxious for information, and have been advised to employ Mr. Croes, or some other expert to come to Oswego and advise them as to the value of the present works and as to the probable cost and working expenses of new works.

We have a population of about twenty-two thousand, an assessed valuation of less than nine million dollars, a bonded indebtedness of one million dollars, and a tax rate of about 3¼ per cent. of actual valuation. N. J. H.

NEWS OF THE WEEK.

Railroads and Canals.

NEVER before could railroads be built and equipped so cheaply as now, and experienced promoters think that next year is destined to see a large number of new lines under construction.

THE Detroit and Cleveland Railway and Steamboat Company will apply for an act empowering them to construct a railway bridge either at Windsor or Sandwich to Kinsville or Leamington.

PROPOSED MISSISSIPPI BRIDGE.—Surveys have been made for an iron bridge across the Mississippi River at Prarie du Chien, to take the place of the pontoon structure. The latter has paid from $35,000 to $50,000 per annum. The new bridge will be built by a stock company, at a cost of $800,000 or more, and will be nearly a mile in length.

DES MOINES, Ia., DECEMBER 11.—Articles of incorporation of the Des Moines Union Railway Company were filed with the County Recorder to-day. The capital stock is $10,000,000. The nature of the business is the construction, ownership and operation of a railway in and around Des Moines.

THE B. & O. R. R. Co., now proposes to reach New York, until its new line is finished, by building 15 miles from its main line at Cherry Run to Williamsport, Md., thence by the Baltimore and Potomac R. R. to Harrisburg. Six miles will have to be built to connect with the South Penna. R. R. bridge at the latter place, where they meet the Reading system.

MEADVILLE, Dec. 14.—The Ohio River and Lake Erie Railroad Company has filed a mortgage in the Recorder's Office for $1,500,000 to secure the first mortgage bonds of the company. The road is now in construction from a point near Sharpsville, Mercer County, through Crawford and Erie Counties, to the city of Erie. It will be about seventy-five miles long and will be built at light cost on the line of the abandoned canal.

BOSTON, Dec. 13.—It is reported that the Grand Trunk proposes to extend its line from Portland to Boston. *The Portland Press* says: "E. P. Hannaford, chief-engineer of the Grand Trunk Road, accompanied by Mr. Lloyd, the assistant engineer, and several subordinates, was in Portland on Wednesday. Several engineers were surveying at Cape Elizabeth and stated that they were engaged in surveying for a proposed new route between Portland and Boston, for the Grand Trunk.

GALENA, ILL., DEC. 8.—A large surveying party under charge of Till, of Caledonia, Minn., reached this city this evening. They have been running a central line through this country in the interests of Chicago, Burlington & Quebec company, who are to build a road from Forreston to Savannah, Ill, thence on the east bank of the Mississippi to St. Paul and Minneapolis.

MARSHALL, MO., DECEMBER 12.—An effort is being made to have a railroad built from this place to the coal fields twelve miles south of this city. The owners of the mines, Bush & Walker, are willing to assist any home or foreign company in building the road. They have on their tract over thirty acres of bituminous and canal coal, and some time ago a shaft was sunk fifty-two feet into the deposit. If the road is built the mines will give employment to hundreds of miners.

"Is it not a pretty state of affairs," said a conservative railroad man recently. "The leading roads of the country are cutting down salaries, discharging men by the thousands, while the passenger and freight agents are slaughtering rates unmercifully. The roads, twelve months from now, would be in better shape in every respect if they would retain their trackmen and their shop employes in service, and discharge freight men and passenger men, who are working for tonnage and glory, regardless of revenue."

CLEVELAND, Dec. 14.—The Receiver of the Toledo and Indianapolis Road has paid all the debts of the corporation, got the road in order, and has $12,000 in the treasury. The court has ordered a sale of the line, and two contending parties are after it, the Indiana, Bloomington and Western and the Toledo, Ann Arbor and Northern Michigan Company, the latter desiring a Southern connection, which would take it to Columbus and the coal regions of Central Ohio.

THE *Railroad Gazette* of December 5th contains information of the laying of track on 84 miles of new railroad, making 3,509 miles thus far in 1884, against 5,819 miles at the corresponding time in 1883, 9,574 miles in 1882, 7,353 miles in 1881, 5,624 miles in 1880, 3,445 miles in 1879, 2,207 miles in 1878, 1,977 miles in 1877, 2,177 miles in 1876, 1,237 miles in 1875, 1,767 miles in 1874, 3,507 miles in 1873 and 6,885 miles in 1872.

JUDGE HAGEMAN recently made a decree that all restraining orders heretofore issued against the Pennsylvania Schuylkill Valley road be abrogated, and that the injunction against the Philadelphia and Reading road be continued. The effect of the opinion will be to give the Pennsylvania Schuylkill Valley road free right of way through Reading for its proposed line to Pottsville along the river front of the city where the Philadelphia and Reading road had laid tracks to obstruct its progress. The decree also permits the new road to lay its sidings in the streets to points where manufacturing establishments can be reached. The new road will now push on to Pottsville.

IT appears that the project of the New York Cable Railroad Co. has not been abandoned. The railroad Committee reported in favor of granting the consent of the city for the routes laid down by Mayor Edson's Rapid Transit Commissioners on June, 30. It had been generally supposed that the law passed by the last Legislature regulating the manner of constructing new city railroads superseded the work of the Rapid Transit Commissioners and left the cable company out in the cold. The Aldermen have already given consent to the construction of surface roads over parts of routes covered by the report of the Rapid Transit Commission and now claimed by the cable roads.

THE Baltimore and Ohio's attempts to get through Philadelphia have again been thwarted. The officials of the road thought they saw their way clear when they secured the charter of an old horse railroad company, and announced their intention of laying tracks up the east side of the Schuylkill under the title of the Schuylkill River East Side Railroad, but they neglected to obtain the consent of the City Councils to occupy the streets. Consequently the city entered an equity suit to prevent the Schuylkill Company from laying tracks across Gray's Ferry road and other streets without having obtained the consent of the Councils.

The Assistant District Attorney Bregy, the master in the suit, filed his report in favor of the city.

WITH regard to the proposed Indo-European Railway, one who seems to be acquainted with the details of the scheme, writes that the whole line from London to Bombay has been calculated to extend over a distance of less than 7,000 miles, and that the entire route can be traversed in nine days at the rate of 35 miles an hour. The whole line, from Tangiers to Bombay, Calcutta, and Madras, can be ready for traffic in less than five years. A special mail train will start from London for Bombay every two days, call at the principal stations only, carry very little freight, and exclude all but first-class passengers; but an express train will leave every day taking passengers, local mails, heavy parcels, post, and articles of value.

ARLBERG RAILWAY INFLUENCES.—A letter from Trieste has just been published on the subject of the influence of the Arlberg Railway on the trade of the Adriatic ports. It seems that although the Arlberg Railway has only been opened a short time the beneficial effect which this new shorter route has on Austrian intercourse with Switzerland and South Bavaria is already apparent. Transmarine cotton, tropical fruits, wines, oils, and even corn are now sent through Trieste, while manufactured goods from Switzerland and Voralberg return through that port. Not only are home-grown and Egyptian cottons sent through to Voralberg and Eastern Switzerland, but it is said that shortly even American cotton will be thus received. The neighboring port of Flume will shortly profit equally by its favorable situation.—*Vienna Dispatch to the London Times.*

THE Michigan State Railroad Commissioner, W. P. Innes, has completed his report which says: "There are 59 railroad corporations in this State, 53 being permanent, the remaining six devoted to a temporary business; since the last report seven new companies have been formed to build 547 miles of road, with a capital of $6,782,000: at present there are 5,044 mills in the State, an increase of 78 miles in the last year. The capital stock of the roads is $260,653,155, the cost $545,978,532, and the indebtedness $328,030,122, making the excess of stock over cost about $42,000,000. The total revenue from traffic for the fiscal years was $90,412,549, and expenses $61,190,996: that of the surplus, $7,337,000, was applied to dividends, $17,000,000 for interest on funded and floating debt, and $5,851,000 for rentals: that the operating expenses were 12 per cent. over last year, and the income increased 26 per cent. Fifteen passengers were killed aud 54 injured; 62 employes killed and 283 injured, 86 others killed and 73 injured, making a total of 579, more than for any other year since the history of the roads. In conclusion the Commissioner states that the existing railroad laws are wisely adapted and there is no room for amendments.

WHEELING, Dec. 13.—In 1866 the Laurel Fork Railroad Company was inaugurated under a special act. Its charter allowed it to charge 75 cents per barrel for transporting oil, it being purely an oil road. In 1873 a general law was passed to cover the franchises of oil corporations, which fixed the rate of freight on oil for certain distances. This act reduced the price for transporting oil on the Laurel Fork road to 50 cents per barrel. Payment being refused suit was entered. The lower court sustained the bill of the railroad, arguing that its charter protected it. The case was appealed and to-day the Supreme Court reversed the finding of the lower court, holding that a railroad company is not protected by its charter, which does not constitute a contract, but is merely a license, subject to any constitutional act of the Legislature; that the right of any railroad company, regardless of its charter, to charge for transportation is absolutely under control of the Legislature, and one Legislature cannot bind another with respect to this subject, it being a governmental power that the Legislature cannot barter away.

THE EASTERN R. R.—The lease of the Eastern R. R. with all its branches and leased lines in Maine, New Hampshire and Massachusetts, to the Boston and Maine R. R., has made the B. & M. the largest railroad system in New England, with over 700 miles of road under one management.

This lease was accomplished lately by a large majority of the stockholders of both corporations, and is to run for fifty-four years. It was attempted last year, but was prevented by the bond-holders of the Eastern, who obtained an injunction from the courts.

Under the new arrangement the roads will be operated in three divisions: viz., the Western comprising the old B. & M. R. R. and branches, the Eastern R. R. and most of its branches in N. H. and Mass., forming the Eastern Division, while the branches leading to Dover, N. H., Lake Winnepiseogee and the White Mts. are to be known as the Northern Division.

General officers have been appointed as follows, most if not all of them having been in the employ of the roads for several years:

Gen. Manager, James T. Furber, with Lucius Tuttle as assistant; Supt. Western Division, William Merritt, Jr.; Supt. Eastern Division, D. W. Sanborn; Supt. Northern Division, John W. Sanborn; Gen. Passenger and Ticket Agent, D. J. Flanders; Gen. Freight Agent, W. J. C. Kenney.

This system has two main lines from Boston to Portland, Me., two lines to the lake region of New Hampshire, one to the White Mts., and through the old lease of the Maine Central to the Eastern, reaches Mt. Desert and all points along the coast of Maine. The roads are all doing a large business, and during the past season, the shore and mountain travel surpassed that of any other year. The new lease promises to be of mutual benefit to both leasee and lessor.

Miscellaneous.

THREE proposals for the establishment of an electric light plant on Ward's Island were opened Dec. 13, by the Commissioners of Charities and Correction, to whom $15,000 was granted for that purpose by the Board of Estimate and Apportionment. The Edison Company's bid was $13,500; the Sawyer Mann Company's $14,078, less $500 if certain fuel be supplied for 30 days, and the Brush Swan Company's, $13,735. The successful bidder will be compelled to furnish two bonds of $10,000 each and guarantee the working of the plant for six months. According to the specifications $876 burners will be used on the island.

A PETITION for certain roads to the Mass. R. R. Commissioners to have the Union Car-coupler adopted was informally heard last week. The general verdict was that it was giving good satisfaction. The Commissioners reserved their decision, and will probably not confine their recommendations to any one coupler.

BIDS will be received up to 12 o'clock of Dec. 23rd, at the office of the Secretary of the Armory Board at 301 Mott Street, New York, for furnishing materials and performing work in the erection of an Armory building at Ninth Avenue 61st and 62nd Streets New York, as follows: Masonry, Iron work, Carpenter work, Plumbing, Steam Heating—each item to be bid on and let separately.

THE city council of Baxter Springs, Kas., has closed a contract with the Missouri Valley Bridge Company, of Leavenworth, for the construction of a substantial iron bridge across Spring River at that place, at a cost of $10,500 in the bonds of the city. The bridge, including "aprons," will be 429 feet in length, with an 18-foot roadway, and will rest upon four pairs of tubular columns.

PUBLIC WORKS IN PARIS.—The expense incurred for new works in the twenty *arrondissements*, or districts of Paris, during the last twenty years amounts to the enormous sum of 654 million francs (£26,160,000), including the following items:—Formation of streets and roads, 191 million francs; maintenance of ditto, 39 million francs; waterworks and sewers, 48 million franc; parks and gardens, 8 millions; and architectural works, 110 million francs.

THE bids put in for the construction of the storm sewers for the relief of the "flooded districts" in Brooklyn, were opened by City Works Commissioner Fleeman yesterday. The lowest bidders for the different sections were Cranford & Valentine, Miles Tierney, and George F. Swift. Owing to the action taken by the Board of Aldermen rescinding the authority of the Commissioner of City Works to advertise for proposals, Mr. Fleeman will not award the contracts until he has received an opinion from the Corporation Counsel in reference to the matter.

THE following is an abstract of the bids for dredging Wicomico River, Md.

Morris & Cummings Dredging Company, New York city, 24½c. per cub. yd., measured in scows.

James Caler & Son, Norfolk, Va., 29½c. per cub. yd., measured in place.

George W. Parsons, Salisbury, Md., 23c. per cub. yd., measured in place; 18½c. measured in dipper.

Baltimore Dredging Company, Baltimore, Md., 24c. per cub. yd., measured in scows; 30c. measured in place.

P. Sandford Ross, Jersey City, N. J., 17c. per cub. yd., measured in scows; 19 9-10c. measured in place.

Frank C. Somers, Philadelphia, Pa., 19 3-4c. per cub. yd., measured in scows; 36c. measured in place.

THE following is an abstract of the bids received for dredging in Wilmington Harbor, Del.

Morris & Cummings Dredging Company, New York city, 18c. per cub. yd., measured in place.

National Dredging Company, Wilmington, Del., 16c. per cub. yd.. measured in scows; 20c. in place.

American Dredging Company, Philadelphia, Pa., 17c. per cub. yd., measured in scows; 22c. in place.

THE following is an abstract of the proposals for the construction and repair of dike in the Rappahannock River, Va.:

Henry Birch, 2105 Pennsylvania Avenue, Washington, D. C.—Construction, $3.60 per lineal foot; repair, $3 per lineal foot.

John H. Dager, Wilmington, Del.—Construction, $7,92 per lineal foot; repair, $6.35 per lineal foot.

Richard M. Payn, 63 Quay street, Albany, N. Y.—Construction, $6.25 per lineal foot: repair, $5.40 per lineal foot.

PROFESSOR HILGARD, UNITED STATES COAST SURVEY.—The most difficult and interesting work of the coast survey is being done in Alaska. Two of our naval vessels are employed there. A careful survey is being made of a number of intricate passages which have not yet been accurately represented on the charts. Alaska has, in one place, an unbroken line of coast 1,800 miles in length. New-York harbor has received careful attention. It was never in a condition so good as it now is. There was never so much water on the bar as there is to-day. There are three feet more than fifty years ago.

VICKSBURG, MISS., Dec. 14.—The Government works at Wilson's Point and in the vicinity of that place, where about $3,000,000 have been expended by the United States Government in improving the Mississippi River, have been closed down for want of funds for carrying on the work.

AT a recent experiment in train lighting by electricity, on the London, Brighton and South Coast Railway, England, a total number of 32 incandescent lamps gave an equivalent of 512 candle power, each lamp being 16 candle power. Twenty-two accumulators were employed weighing with the dynamo 3,000 lbs. The electricity is generated on the train as soon as it has attained a speed of 15 miles per hour. Oil lamps, with their breakage and labor, cost the company £15,000 per annum, and it is expected that a saving will be effected by the use of electricity.

NEAFIE AND LEVY, shipbuilders of Philadelphia, have been awarded the contract, by the Panama Railroad Company, for the building of the most powerful tugboat in America, if not in the world. The boat is intended for service in Panama Bay, and, the water being shallow, she will be propelled by the twin screw system. She will be built of iron, 130 ft. long, 23 ft. wide and 10 ft. deep. Two compound condensing engines will be supplied with steam by two steel boilers of 650 horse-power. The speed of the boat will be 12 miles an hour. The boat will be completed in four months, at a cost of $55,000, and then be taken through the Straits of Magellan to her destination.

THE seventh annual meeting of the Illinois Tile-Makers Association will be held in Springfield, Ill., on Jan. 20 and 21, 1885. A number of interesting papers will be made on drainage generally. At the latest reports there were about 600 tile factories in the State, constructed at an average cost, including real estate, of $3,000 each, making the amount invested in the business about $1,800,000. The factories employ about 5,400 men for about seven months of the year. The average wages paid men and boys, including board, is about $30 per month, making the annual disbursements in the State for wages not far from $1,134,000. The annual capacity of the 600 tile factories in the State is estimated to be 56,000 miles. The average price paid for laying tile is about 25 cents per rod or $80 per mile, costing $4,488,000 for laying these tile annually.

TRENTON, N. J., Dec. 14.—The proposition to build a bridge across Staten Island Sound joining the States of New York and New Jersey, is again the subject of comment. The act permitting the erection of the bridge failed to pass Congress at the last session, and it is said that it will be difficult to put it through at this session. The measure will be strongly opposed by the Jersey representatives, as being part of a serious movement, it is said, to divert railroad traffic from the New Jersey Shore to the water front of New York. There are many advantages possessed by Staten Island as a railway terminus, which do not exist in New Jersey. A proposition has been made to tunnel under the Narrows and utilize the Long Island water-front, where the vessel anchorage is of the best. The water-front at Jersey City and Hoboken is now entirely occupied and another railroad corporation seeking entrance to New York must either use the frontage now owned by another company or go to Staten Island.—*N. Y. Tribune.*

WASHINGTON, D. C., December 12.—The report of the Committee of the National Academy of Sciences upon the organization of the signal service, geological survey, coast and geodetic survey and hydrographic office of the Navy Department is made public. After describing the work of the various bureaus and pointing out some existing defects, the committee are of opinion that the functions of the several organizations under consideration could now be most advantageously divided among perhaps four bureaus, namely; 1. Coast and interior survey, to be concerned principally with geodesy and hydrography, and to consist of the present coast and geodetic survey. 2. Geological survey to comply the present geological survey with its organization unchanged. 3. Meteorological bureau, to which should be transferred so much of the present personnel and functions of the chief signal office as are not necessary to the military duties of that office. 4. A physical observatory to investigate laws of solar and terrestrial radiation and their application to meteorology, with such other investigations in exact science as the Government might assign to it. The committee recommend the organization of a permanent commission to prescribe a general policy for each of these bureaus.

TOPEKA, KAN., December 8.—The Secretary of State has issued a charter to the Kansas Cement Works Company, of Wyandotte, Kan., and Kansas City, Mo., organized for the purpose of operating quarries of cement rock and other rock, the manufacture of cement and fire clay in all forms, manufacture of artificial stone and drain pipe of all kinds, and the transaction of all business in any way pertaining to the sale of these products. The Directors of this organization are John Q. Adams and Charles Francis Adams, Jr., of Quincy, Mass.; Charles F. Morse and E. E. Richardson, of Kansas City; M. McAlpine, T. A. Scott and Edward Haren, of Wyandotte. The amount of capital stock is $100,000.

THE PROPOSED NATIONAL BOARD OF HEALTH.—The Committee on Federal Legislation appointed by the national conference of the State Boards of Health has completed its bill which embodies the views of the conference as to the best method of preventing the introduction into the United States of cholera and other diseases dangerous to public health. The first of the ten sections comprised in the bill provides for a National Board of Health, to consist of one member from every State health board now or hereafter established, to be appointed by the President and confirmed by the Senate. This differs from the original act in that it largely increases the membership of the board and excludes from it medical officers from the army, navy and marine hospital service, and law officers from the Department of Justice.

The second section of the new bill provides, as did the corresponding section of the original act, for the collection and dissemination of sanitary information, etc., but greatly enlarges the scope of the board's powers by authorizing it to frame rules and regulations for the Government of quarantine service of the United States, and by the vesting in it (the board) all authority which is now or may hereafter be provided by law for the control and protection of the public health. It directs the National Board to co-operate with local boards as far as it lawfully may, and aid in the enforcement of the latter's rules and regulations, but it authorizes the National Board, upon direction of the President, to act in the several States independently, and make and enforce there its own rules, regardless of local boards.

The third section relates to the regulation of marine quarantine service, and authorizes the National Board to frame rules to be observed by all vessels sailing from foreign ports to ports of the United States, and provides that such rules, when approved by the President and issued by the Department of State, shall be enforced by all consular officers and agents of the United States, as well as by medical officers serving under this act.

Section 4 provides that any vessel from any foreign port which shall attempt to enter any port of the United States in violation of the above mentioned rules and regulations shall be liable to process in the proper District Court of the United States, and upon conviction shall forfeit to the United States a sum to be awarded in the discretion of the Court, not exceeding $1,000, which shall be a lien upon the vessel. In order to show that it has complied with these rules and regulations, every vessel shall be provided with a proper certificate from the United States consular or medical officer at the port of departure, who must be satisfied that the statements therein contained are true.

Section 5 provides for a similar observance of these rules and a corresponding certificate from the health officer at the port of entry.

Section 6 authorizes the President of the United States, in any threatening emergency, to make known by proclamation measures which he may think necessary to meet it, such as suspending the introduction by land or sea of any dangerous kind of merchandise, or prohibiting entirely entry into the United States ports of vessels from infected countries. He shall at the same time convene the National Board of Health in special session, and measures revised by the latter shall, upon approval by the President, supercede the Executive proclamation.

The remaining four sections provide for the collection by consular officers of santitary statistics and information in foreign ports; for a detail by the President of departmental officers to serve temporarily under juridiction of the board without compensation; for an appropriation of $500,000 to meet the expenses incurred in carrying out the provisions of the bill, such sums to be disbursed under the National Board's direction, and by its own disbursing agents, and for the repeal of all acts inconsistent with the terms of this one.

A delegation of physicians and members of State boards of health placed the bill in the hands of the House Committee on Public Health this afternoon.

BIDS ON NEW CROTON AQUEDUCT—OPENED DECEMBER 8, 1884.

NAMES.	SECTION A		SECTION B		SECTION 9		SECTION 8		SECTION 7		SECTION 6		SECTION 5		SECTION 4		SECTION 3		SECTION 2		TOTALS.
		No.		No.		No.		No.		No.		No.		No.		No.		No.		No.	
Arnold, Gere & Stevens	1,296,630	10	1,376,302	10	1,667,700	12	1,420,020	9			674,005	9	808,385	7							5,760,652
Bailey, Dan'l E																	1,945,600	9			1,945,600
Brown, Howard & Co	1,053,650	2	1,150,687	2	1,340,662	2	1,071,430	1	1,301,660	1	599,405	4	726,975	3	1,518,475	1	1,398,050	1	1,653,655	1	11,814,849
Beckwith, Quackenbush & Co.	1,151,540	6	1,243,432	3	1,496,725	4															3,891,707
Clark, Heman	1,051,675	1	1,096,065	1																	2,147,740
Collins & Rider	1,146,090	4	1,243,761	4	1,501,109	6	1,282,225	3	1,527,065	3	652,240	6	799,455	6	1,756,087	5	1,677,730	4	1,952,200	5	13,537,953
Dowdney, Abraham	1,146,045	3	1,276,386	6																	2,422,431
Del Genovese, Virgilio																	1,733,723	6			1,733,723
Dickinson, P. P					1,418,904	3					592,875	2	731,365	4							2,743,144
Douglass, Dalzell & Douglass*	1,209,058	8	1,315,576	9	1,589,407	8	1,365,759	6	1,620,360	5	744,965	13	865,325	9	1,794,841						10,505,291
Dowling & Kennedy					1,499,487	5					658,450	7									2,157,937
Duffy, Edward																			2,286,750	8	2,286,750
Malone, McGrann & Co											596,500	3	725,045	2	1,637,430	3	1,588,710	3	1,744,050	3	6,29 ,7 5
McQuade, John	1,307,652	12	1,413, 768	13																	2,721,420
O'Brien & Clark					1,333,237	1	1,157,285	2	1,376,765	2	578,140	1	701,210	1	1,529,787	2	1,486,700	2	1,721,800	2	12,032,344
Phelps, H. W							1,428,380	10	1,696,061	9	672,115	8									3,796,556
Phelan & Westbrook											613,605	5									613,605
Swift & McNamee					1,561,000	7															1,561,000
Smith & Beard													1,184,585	13	1,907,725	9					3,092,310
Smith, Hamilton, Jr.**	1,288,760	9	1,403,855	12	1,741,375	14	1,518,515	11	1,773,290	10	796,525	14	984,700	11	1,941,925	10	1,929,200	8	2,085,050	7	15,463,105
Smith & Brown					1,651,212	11	1,391,190	8	1,644,125	6	716,760	11	873,725	10	1,879,275	8					8,156,227
Smith, Rutter & Ripley***	1,304,285	11	1,397,560	11	1,674,400	13	1,388,965	7	1,648,535	7	732,725	12									8,146,470
Soule, Howard	1,308,072	13	1,304,130	7	1,633,000	10	1,344,140	4	1,597,435	4	675,185	10	821,620	8	1,771,195	6	1,689,005	5	1,840,905	4	13,974,687
Tierney, Miles													782,850	5	1,660,282	4					2,443,132
Ward, Mackin & Co	1,148,880	5	1,305,440	8																	2,454,300
Weber & Wendt†	1,157,180	7	1,251,845	5	1,594,580	9	1,361,885	5	1,664,680	8	825,510	15	991,400	12	2,108,786	11	1,757,240	7	1,971,275	6	14.684,311

* Will accept from one to four sections.
** Will only accept for whole work.
*** Will not accept a contract except for four consecutive sections.
† Will accept a contract for any two contiguous sections.

DETAILS OF BIDS ON SECTION 4 NEW CROTON AQUEDUCT, OPENED DECEMBER 8, 1884. (SEE NOTE).

SECTION 4.	Brown, Howard & Co.	O'Brien & Clark.	Malone, McGrann & Co.	Miles Tierney.	Collins & Rider.	Howard Soule.	Douglass, Dalzell & Douglass.	Smith & Brown.	Smith & Beard.	Hamilton Smith, Jr.	Weber & Wendt.	Average of all bids.
(a) 37,000 c. y. Rock excav. in open trench	2.00	1.75	2.00	2.50	2.00	2.00	2.15	3.00	4.00	2.00	5.00	2.58
(b) 82,000 c. y. Earth excav. in open trench	90	80	65	1.00	1.30	1.30	88	1.75	1.00	80	3.70	1.28
(c) 7,000 c. y. Boiling	75	40	50	50	80	1.00	75	75	1.00	35	75	69
(d) 121,000 c. y. Tunnel excav	6.40	7.00	7.50	7.00	8.00	8.00	8.35	8.00	8.00	9.75	7.50	7.80
(e) 288 lin. ft. Large Shaft Excav	100.00	150.00	110.00	200.00	145.00	65.00	70.00	100.00	125.00	100.00	85.00	113.63
(g) 29,500 c. y. Brick Masonry	11.00	10.00	11.00	12.00	11.00	11.00	11.75	14.00	12.50	12.00	14.00	11.84
(h) 8,000 c. y. Concrete—5 to 1	5.00	5.00	6.00	5.00	5.25	6.00	6.00	6.00	6.50	7.00	5.00	5.70
(i) 2,000 c. y. " —3 to 1	6.00	5.50	6.50	6.00	6.00	7.00	6.50	7.50	8 00	8.00	5.50	6.60
(j) 18,500 c. y. Rubble Stone	6.00	5.00	6.00	5.00	6.00	7.00	5 80	4.00	7.00	6.00	7.00	5.90
(k) 6,000 sq. ft. Rubble Facing	20	80	30	75	30	50	14	35	30	15	1.50	48
(l) 500 c. y. Dry Rubble	7.50	2.50	5.00	2.00	3.50	3.00	3.95	3.00	5.00	4.00	3.75	3.93
(m) 125 c. y. Rectangular Paving	15.00	2.50	6.00	4.50	3.50	8.00	7.85	8.00	8.00	8.00	6.25	7.05
(n) 150 c. y. Cut-stone Masonry	50.00	40.00	40.00	40.00	40.00	50.00	30.00	40.00	36.00	35.00	50.00	41.00
(o) 6,000 sq. ft. Rough Pointing	25	80	12	75	30	40	15	35	50	15	50	39
(p) 2,500 " " 6-cut Work	75	90	20	75	50	80	25	50	2.00	25	58	68
(q) 250 M. B. M. Timber	50.00	30.00	40.00	30.00	45.00	40.00	45.00	35.00	38.00	35.00	42.00	40.00
(r) 9,000 lin. ft. Piling	50	25	35	35	40	50	40	35	50	40	23	39
(s) 2,000 c. y. Masonry in Port. Cement	2.50	1.50	1.00	2.00	2.00	1.00	1.50	1.25	2.50	2.50	1.50	1.75
(t) 2,000 c. y. Masonry Am. Cements 1 to 1	1.00	1.25	50	1.50	1.00	75	75	1.00	1.00	1.20	1.00	1.09
(u) 2,300 c. y. Shaft Filling	75	40	75	40	80	1.00	75	75	1.00	50	1.00	73
(v) 10,000 lin. ft. Drain Excav	1.00	1.00	1.50	1.75	80	1.25	90	1.50	3 00	10	2.00	1.35
(w) 1,000 " " 6" Drain Pipe	30	30	40	40	50	60	60	40	60	10	35	41
(x) 1,000 " " 8" " "	45	40	60	60	65	80	80	60	75	10	50	57
(y) 1,000 " " 10" " "	60	65	75	80	75	1.00	1.00	1.00	1.00	10	85	77
(z) 1,500 " " 12" " "	70	90	87	1.00	1.00	1.25	1.20	1.20	1.25	10	95	98
(w) 1,500 " " 15" " "	1.15	1.25	1.00	1.50	1.25	1.60	1.30	1.30	1.40	10	1.50	1.30
(x) 1,500 " " 18" " "	1.25	1.50	1.20	1.75	1.75	2.00	1.40	1.60	1.60	10	1.85	1.45
(x) 5,000 c. y. Borrowed Earth	50	30	75	50	60	1.00	60	30	75	30	60	56
Total Estimate	$1,518,475	$1,529,758	$1,637,430	$1,660,283	$1,756,088	$1,771,195	$1,794,841	$1,879,275	$1,907,725	$1,941,925	$2,108,786	$1,773,250

NOTE.—An examination of the total section bids, opened at the above letting, shows a remarkable evenness in the prices of each individual bidder; these prices varying only as required by the slight modifications in the work on the various sections. This being the case we have selected for publication and comparison the detail of bids on a typical Section of the Aqueduct; one containing the bulk of the items and bidders, and answering fully the general purpose of comparing the views of the various bidders on the work let.

THE following Proposals were received on the 16th inst. for a Sea Wall, Filling, etc., for the Boston Park Department. The work embraces a sea wall 2,268 ft. in length, of coursed granite masonry laid in cement, resting upon a pile and timber foundation except for a length of 435 ft. where the foundation is to be of split stone masonry.

Item "a" consists of round spruce piles, not less than 10 in. in diameter where cut off for capping, to be furnished, driven and cut off to receive capping. About ¼ of the piles are to be driven with an inclination of 1 horizontal in 2½ vertical.

Item "b" consists of 10"×10" spruce timber, placed crosswise of the wall, notched down 2" on each pile, trunniled to same and covered with a flooring of 3 in. spruce plank.

Item "c" consists of quarry chips or broken stone from 2" to 6" in diameter, deposited between the pile caps and outside of the platform.

Item "d" is split stone masonry, for the wall foundation, where the bottom is of rock and pile foundation, cannot be used.

	Parker & Sylvester, Boston.	O. Conner & Co. Boston.	Joseph Ross, et al. Ipswich, Mass.	G. H. Cavanagh, Boston.	C. A. Trumbull, et als. Boston.	Moore & Wright, Portland, Me.	H. H. Pike, Cambridge, Mass.
a 5,100 spruce piles driven and prepared	$3.25	5.	4.50	5.	4.	4.50	5.50
b 160 M. ft. B. M. spruce lumber in plan	24.00	25.50	40.	30.	42.	40.	30.
c 5,000 cubic yards of ballast	1.40	1.10	2.	1.80	1.42	2.50	2.25
d 1,500 " " " split stone masonry	15.17	12.15	16.	13.	18.60	25.	25.
e 6,150 " " " wall masonry	10.30	8.50	9.50	11.	12.12	14.50	18.
f 560 " " " coping stone masonry	27.00	37.80	30.	25.	38.62	35.	40.
g 6,000 " " " dredged earth for filling	0.37	0.45	0.40	0.50	0.41	38	60
h Removal and disposal of sea wall, etc	1800.00	1540.	2000.	2000.	4119.	4000.	5000.
i " of a portion of Canal Bridge, etc	500	800	800.	1000.	1200.	1000.	5000.
j " " " " West Boston, etc	500	950	600.	600.	1200.	1000.	5000.
Total amount of contract	153,625	156,870	165,975	173,050	189,404.20	216,925	265,700

It is to be composed of rectangular blocks of granite, 6 ft. or more in length, with straight and even beds and builds with a rise exceeding 18 inches, laid without mortar in horizontal courses.

This foundation is to be laid below low water mark and the price bid includes the cost of leveling the ledge to receive the foundation masonry.

Item "e" includes the wall proper which rests on the pile or granite foundation, is 12 ft. high, 7' 9" thick at bottom, 4' 7" thick at top, composed of six courses of rectangular granite blocks with joints not exceeding one inch in width, laid in cement mortar.

Item "f" is the wall coping, composed of granite stones 5 ft. wide, 15 in. thick and not less than 6 ft. in length; all exposed surface to be fine pointed work and joints not to exceed ⅛ in. in width.

Item "g" is earth filling to be dredged from the Charles River, near the site of the work, and deposited in the rear of the wall. This material is to be measured in scows.

Items "h," "i" and "j" are for removing existing structures from the site of the work, etc.

PANAMA, Dec. 4.—The first of the Scotch dredges for canal work arrived in this bay on Nov. 24, having made the voyage from Scotland in eighty-eight days. The dredge is 170 feet long, her greatest breadth is 26 feet, and her depth 12 feet. She has two compound engines—one for driving the vessel and one for working the dredging machinery. Each engine is 80 horse power, but can be worked up to 400. When clean she steams eight knots an hour. She is the most powerful vessel of the class yet bought by the canal company, and she will be followed by several others. Their special work will be cutting the main channel in shore, from in front of the anchorage of the steamers at Flamenco to the entrance of the canal at the back of Ancon Mountain. By January it is expected that at least two of them will be at work.